

# Aviation Week & Space Technology

April 30, 1962

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Thin Film Diode  
Breakthrough  
In Microcircuitry

Vickers VC.10





The Visicorder Oscillograph records transducer response

A Type JIN-100 "Silicon" temperature transducer, made by the Rdf Corp., Hudson, N.H., is being tested here on a Visicorder Oscillograph.

The transducer is immersed in an ice bath and then in boiling water. If the tiny welded grid is not adequately bonded to the rubber carrier material, the temperature response to the cold/hot bath is seriously changed. The Visicorder-Oscillograph record shows that the Rdf transducer under test had a proper grid-to-matrix bond because it met the specified time response to temperature change.

In countless applications, Visicorder Oscillographs can directly record up to 36 channels at frequencies from DC to 5000 cps.

For details, write Minneapolis-Honeywell, Hydron Division, 4800 E. Dry Creek Road, P.O. Box 5378, Denver 10, Colorado. Our DDD phone number is 303-796-4311.



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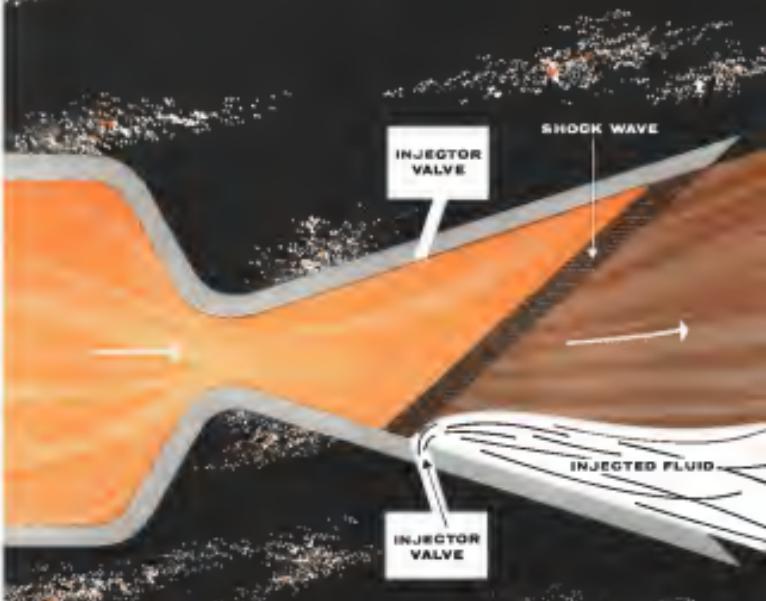
**H** Fast in Control

TIME RESPONSE TEST. —  
TYPE 3-2-64 — S/N 2  
TEMP. 3.2 °F TO 2.2 °F  
6.5% SILENTTIME 7 SEC.  
90% RISETIME 1.5 SEC.  
ORDER NO. 13050 FOR MUR.  
DATE 6/29/64 TEST BY HC

## CAPABILITY is spelled

s-e-c-o-n-d-a-r-y i-n-j-e-c-t-i-o-n

The Aerospace Division of Vickers Incorporated has successfully completed a secondary injection thrust vector control system R&D program for the United States Navy.



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## How to keep a rocket ready



**Silicone rubber blanket  
keeps rocket fuel  
at constant temperature**

Keeping the solid fuel of the NASA Scout launch vehicle at approximately 80° F required a heating blanket that meets two major design requirements. First, the blanket must be flexible for easy installation and handling. Equally as important, it must operate in any kind of weather.

These design features capture the blanket manufacturer to choose materials with care. The matrix must be elastomeric and heat resistant. Since the heating energy is electrical, the blanket material must have electrical insulation qualities too.

Silastic®, the Dow Corning silicone rubber was selected. No loss of flexibility or mechanical damage by temperatures from -130 to 500 F, moisture resistance and good electrical insulating properties all combined to make Silastic the ideal elastomer for this unusual application.

If you need gaskets, control cables, oil seals or other ground support equipment parts made from rubber, consider the chart of Slinite properties below.

Extracts from Plant Actions on Termites, Scolytinae Species

Temperature	Hours	Flame Life*	Endurance, Hours A
300°F	0	OK	54
	168	OK	39
	336	OK	64
	605	OK	65
302°F	0	OK	53
	166	OK	35
	316	OK	62
	540	OK	68
400°F	0	OK	54
	168	OK	60
	336	OK	30
	605	OK	30

<sup>10</sup> 1997 budget of 51.2 million versus 50.2 million = no change.

For more detailed information about Sili-  
conized natural rubber and a list of pur-  
chasers, write Department 1455, Dow Corning  
Corporation, Midland, Michigan.



**Dow Corning**

## AEROSPACE CALENDAR

May 7-9-**5th Annual 25th Anniversary Congregational Banquet** Statler Hilton Hotel, Washington D C

May 7-9-**Materials & Processing for Space Environment Symposium**, Society of Automotive Engineers, Phoenix, Ariz.

May 8-10-**Annual Meeting**, Hotel Statler, Boston, Mass.

May 9-10-**Annual Conference**, Society of Photographic Scientists and Engineers, Statler Hotel, Boston, Mass. *Cancelled*

May 13-16-**Test Equipment & Engineering Conference**, Public Auditorium, Cleveland, Ohio

May 9-10-**Management Conference on Manufacturing in the Defense Industry**, Boston College, Chestnut Hill, Mass. *Cancelled*

American Manufacturing Assn., Bureau of Research Research, Boston College

May 8-9-**12th Annual Electronics Component and Assembly Show**, Marquette Hotel, Washington D C

May 10-16-**60th Annual National Conference on Pneumatic Arms of Space**, Seattle, Wash. *Cancelled*

National Aerospace and Space Administration

May 11-12-**10th Annual Meeting**, Dearborn Inn, Dearborn, Mich. *Cancelled*

May 12-13-**Annual Meeting**, Hotel Statler, San Jose, Calif. *Cancelled*

May 14-15-**Western Regional Convention**, San Francisco, Calif. *Cancelled*

May 14-15-**National Aerospace Electronics Conference**, Institute of Radio Engineers Statler Hotel, Dayton, Ohio

May 16-18-**Annual Meeting**, Sheraton-Park Hotel, San Francisco, Calif. *Cancelled*

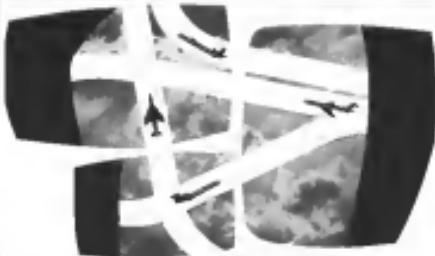
**SWEDEN AND NORWAY  
CHOOSE SELENIA ATCR-2  
AIR TRAFFIC CONTROL  
RADAR**

After a detailed analysis of competitive radars by the technical and operational experts of Sweden and Norway, SELENA radars will be chosen. SELENA ATCR-9 dual-channel air traffic control radars are to be installed at Stockholm (Brunnsvik) and Oslo (Fornebu) airports. These radars are ideally suited for coping with today's traffic problems. Long-range air traffic control involves detection of even small jet aircraft. Close-in approach and departure control involves high data-rate and extremely high target visibility within heavy fixed radar clutter. The SELENA radar solves both requirements.

Can the ATCR-2 help with your air traffic control problems as it will in these countries?



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Postscript: Please note that 100% by volume means 100

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## AEROSPACE CALENDAR

(Continued from page 5)

meet of Defense Symposium on Thermionic Power Conversion, Antimatter Beam, Colorado Springs, Colo.

May 14-17—11th Annual National Conference, Society of Aerospace Vehicle Designers, Phoenix Hotel, Seattle, Wash.

May 16-18—Spring Meeting, Society for Experimental Stress Analysis, Sheraton Dallas Hotel, Dallas, Tex.

May 17—Biplane Meeting, Jim Tamm's, Inc., El Cajon, General Motor Corporation, Indianapolis, Ind.

May 20-24—Annual Conference, American Assn of Airport Executives, Ambassador Hotel, Los Angeles, Calif.

May 20-25—Annual Meeting, Aviation Journalists, Western Aircraft Park, Flagstaff, Ariz.

May 21-23—Annual Meeting and Aviation Safety Seminar, National Fire Protection Assn, Sheraton Hotel, Honolulu, Hawa.

May 21-25—Second Annual Air Transportation Conference, New York University, Washington Square Center, New York, N.Y., Computer International Transportation Institute.

May 21-23—Eightieth Aerospace Instruments for Aerospace and Medical Testing Meeting, Conference Services, Ft. Monmouth, N.J., D.C.

May 22-23—Conference on Self-Defense Systems, Missouri of Science and Industry, Chicago, Ill., Sponsored Office of Naval Research, Aerospace Research Division.

May 22-24—National Maritime Therapy & Transport Research Institute of the U.S. Army Engineers, Woods Hole, Colo.

May 24-26—Seventh Annual Conference on Space Communications, Institute of Radio Engineers, Seattle, Wash.

May 25-27—International Space America, Yacht International, Miami, Fla.

May 26-28—Annual Meeting, Society of the Aerospace Sciences, Los Angeles, Calif.

May 27-June 2—14th Annual Wright Memorial Glider Meet, Ft. Meade, Md., Information Society of the U.S. Air Force, Ft. Meade, Md., 21 Dec., 1968.

June 4-7—1963 National Congress, Statler Hilton Hotel, New York, N.Y.

June 8-Twelfth Annual Standards for Film and Optical Materials, French, Naval Defense Laboratories, Silver Spring, Md.

June 10-12—Tenth Annual Meeting, Institute of Science and Technology, Radar Laboratories, University of Michigan, Ann Arbor.

June 19-20—13th National Maintenance and Operations Meeting, Reading Aviation Service, Inc., Reading, Pa.

June 21-23—National Conference, National Aviation Education Council, Seattle, Wash.

June 23-25—Annual Meeting, Han Tumlin and Fred Mechanics Institute, University of Washington, Seattle, Wash.

June 25-Aug. 16—Aerospace Subject Matter Institute, University of South Florida, University of Florida, Gainesville, Fla.

June 26—National Science Foundation (Continued on page 9)

## Involvement: LIFE



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W



### CONTRIBUTION...

"The great use of a life is to spend it for something that outlasts it." —W. James

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## AEROSPACE CALENDAR

(Continued from page 7)

June 19-21—19th Meeting: Aviation Distributors and Manufacturers Assn., Ambassador Hotel, Los Angeles

June 20-22—Second Meeting, Institute of the Aerospace Sciences, Andradeo Hotel, 86 Los Angeles Calif.

June 20-23—Annual Convention: Airline General Transportation Assn., Beverly Hotel, New York, N.Y.

June 23-27—Sixth National Conference on Engineers, Managers, and Analysts of Radio Engineers, Marquette Hotel, Washington

June 25-28—Symposium on Electromagnetic Theory & Application, Congressmen's Hotel, Spokane, Technical University of Denmark, International Scientific Radio Union

June 25-28—Aerospace Conference, American Society of Mechanical Engineers, University of Maryland College Park, Md.

June 26-28—19th National Meeting, American Meteorological Society, University of Alaska, Fairbanks, Alaska

June 27-28—Annual Meeting, Department on Computers and Data Processing, in the University of Denver's Denver Research Institute, Elkhorn Lodge, Piney Park.

June 27-29—Joint Aerospace Control Conference, Institute of Radio Engineers, New York University, New York, N.Y.

June 27-29—Annual Meeting, Institute on Radio Frequency Interactions, Institute of Radio Engineers, Times House, San Francisco, Calif.

July 17-19—Joint Meeting, American Rocket Society, Park Central and Stratford Hotel, North Columbus, Ohio

Aug. 13-15—Festival of Motion Picture, Television and Radio, Institute of the Aerospace Sciences, Diversey Hotel, Seattle, Wash.

Aug. 16-17—Nordic Projection Conference, Monterey, Calif., Joint Meeting, Institute of the Aerospace Sciences, American Society of Motion Picture Engineers

Aug. 21-24—Western Electronic Show and Conference, Institute of Radio Engineers, Los Angeles, Calif.

Aug. 23-Sept. 1-7-1981—Second International Conference, National Organization for the Advancement of India

Aug. 27-29—Symposium on Ballistic Missiles and Space Technology, State Hilton Hotel, Los Angeles, Calif., Sponsor: U.S. Air Force, Aerospace Corp.

Aug. 27-Sept. 1—Third International Conference on Space Technology, Council of the National Sciences, New Congress Hall, New Haven, Conn.

Sept. 1-5—Flight Displays and Exhibit Show, Society of British Aircraft Constructors, Birmingham, England

Sept. 14-16—Joint Annual Meeting, International Air Transport Assn., Hotel Dixie, Sept. 16-18—1981, National Convention & Aerospace Foundation, Air Force Assn., Las Vegas, Nev.

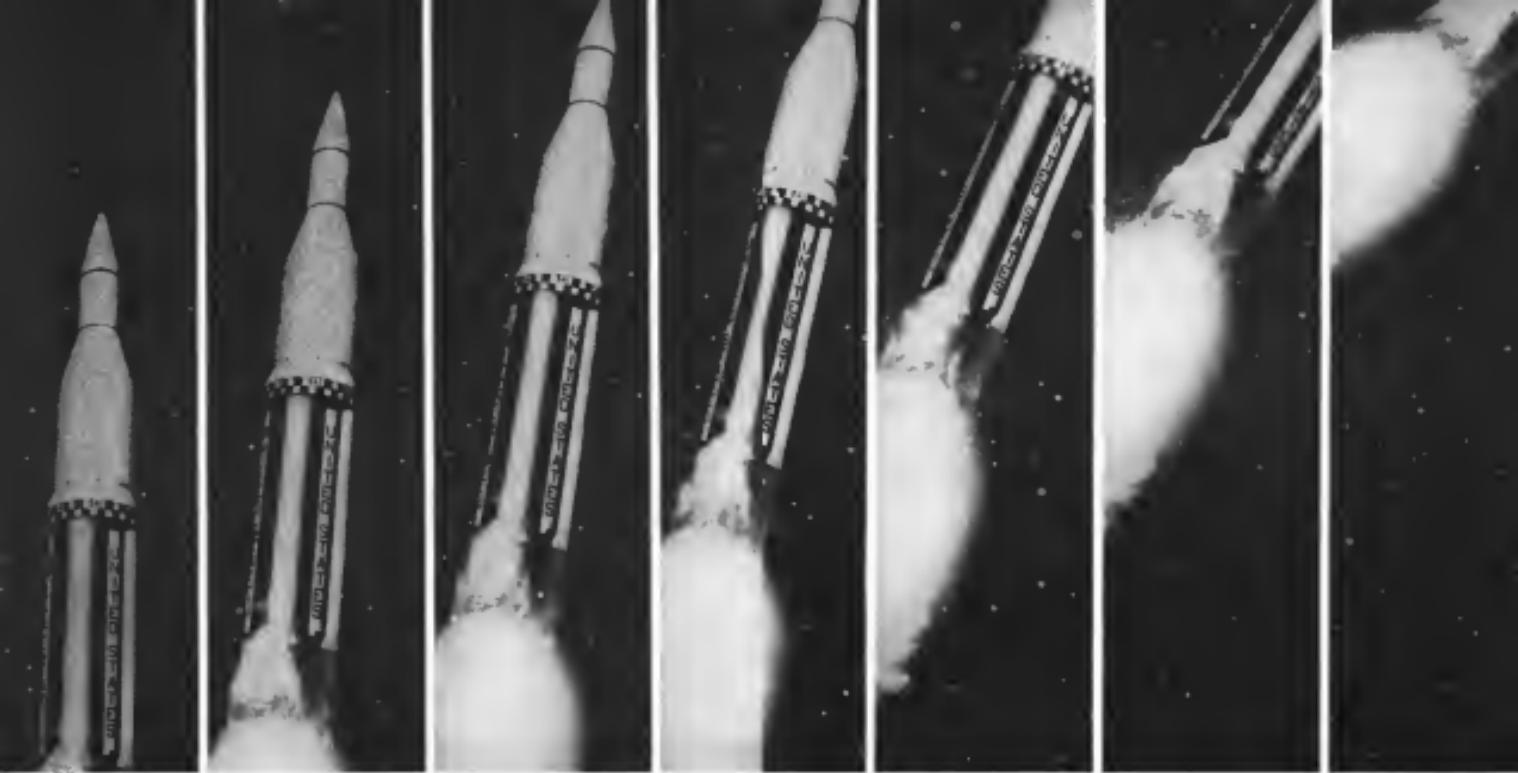
Oct. 29-31—Symposium on Dynamics of Material Lifting, University Estate, Plaza de la Universidad, Madrid, Spain, for the International Institute, M. Sohni, General Chairman, Room 10103A, General Elec Co, NBS, Valley Forge Space Technology Center, Box 8755, Philadelphia, Pa.



## Space age forge

Fabricating and forming the metals for missiles requires a degree of manufacturing sophistication and precision that can be met by relatively few organizations. The Marquardt Corporation is one of these qualified subcontractors. Marquardt Manufacturing facilities were built and equipped specifically to produce the intricate components, sub-systems, and systems necessary to the national defense. Our large plants provide modern heat treating and metal processing equipment,稻花 forge, high-energy forming, machine tools and all supporting equipment, plus a work force experienced in handling aerospace problems. For a recognized subcontractor with a total in-house capacity, capable of producing economically and on-time, consult Marquardt Manufacturing. For further information write or call H. C. Peitz, Department A, Manufacturing Services.

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Eclipse-Pioneer advanced inertial guidance systems give missiles, boosters and space vehicles warning—"target instinct"—whatever the mission. Proof?

Take the Pershing, Army's "shoot and scoot" missile. Flight tests have demonstrated the flawless accuracy of the inertial guidance system—built by E-P—which utilizes our ultra-sensitive air-bearing gyros and accelerometers. Per-

formed has continually exceeded project specifications. And production has been consistently ahead of schedule.

Take the Saturn C-1, NASA's super rocket earmarked for manned space flight. E-P has been selected to build the highly complex guidance platform because of our knowledge in space age techniques and our proven success on the Pershing missile.

## BUILT IN!

Investiveness, imagination and experience play key roles in Eclipse-Pioneer's ability to solve the difficult and complicated problems associated with the science of inertial guidance. When it comes to state-of-the-art in manufacturing techniques, E-P takes the lead. For example, tolerances of 10 millionths of an inch and one second of arc are consistently maintained in our own Bayham production machinery.

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# ROTX

AND WORLD WIDE SERVICE

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AEROSPACE  
SYSTEMS MANAGEMENT BY LEAR

**The Task:** To Achieve The Ultimate In Mission Accomplishment For Aerospace Systems, With Man "In The Loop".

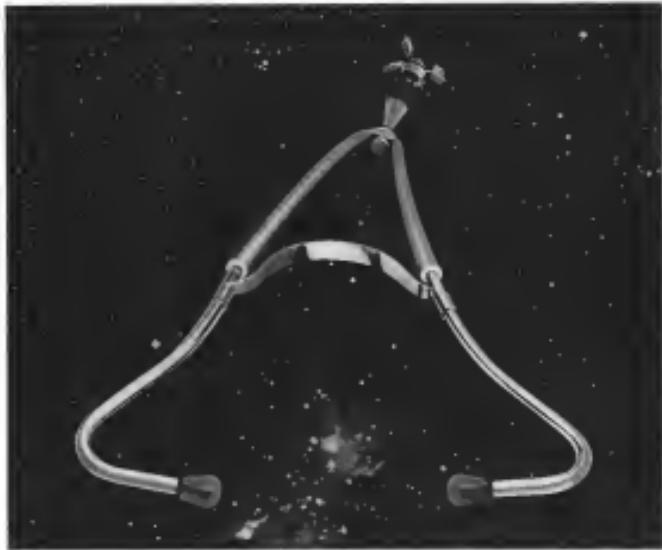
**The Solution:** Translation of Man/Machine Technologies Into Integrated Control and Display Systems Through Refined Management Techniques

Acquisition of technical information required for the development of avionics systems must be rapid and efficient. By solving the problems of a system at its inception, the most effective way of acquiring the necessary technology can be determined and implemented quickly. Deciding the needs for data display is equal in importance to the development of the methods of display. The capability of Lear to translate system requirements into operate control and display hardware is widely recognized. Lear experience involves the development of wholly integrated systems for supersonic aircraft and space vehicles, and Lear possesses exceptional ability to acquire, process and display technical information for the ultimate in mission management. We call it Control Display Systems MANAGEMENT.



**LEAR**

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From the first important space probe efforts, Siegler has participated in these programs...major contributions

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Siegler designed and produced—including complete fabrication of the antenna, all mechanical components and

electrical instrumentation—and installed in record time.

In this tracking system, every minute part of the giant,

60-foot parabolic antenna is more precisely machined

for use than the parts of a fine watch. The result: not only the greatest tracking accuracy ever achieved in an antenna of this type, but also the extreme sensitivity required for clear reception of faint signals from far distances in outer space.

The vital area of space communications is only one

phase of Siegler versatility. In today's major aerospace programs, Siegler supplies meteorological electronics including completely automatic weather stations;

missile launch check out systems; zero space struc-

tures; solid state space television and many other

contributions to military and research projects.

Every Siegler contract includes the asset of divisional

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CREATING A CHARTER SCHOOL: THE CASE OF THE HIGH SCHOOL FOR CRITICAL THINKING



April 30, 1943

# Aviation Week & Space Technology

Vol. 76, No. 11  
November 1972

## Management in a New Environment

(Mr. Glen C. H. Mitchell, vice commander of the Air Force System Command, recently outlined to the National Society Industrial Arts in Philadelphia some of the photo plots, activities and future plans of Air Force management. Because management is becoming a vital factor in today's rapidly advancing technology, AVIATION Week is publishing excerpts from Mr. Mitchell's address.)

In today's new scientific environment, it is essential that our management practices keep pace with and be responsive to the rapid advance of technology. Just over a year ago the Air Force took a major step towards this objective. Following an extensive Air Force management study, the Secretary of Defense announced the formation of the Air Force Systems Command, effective the first of April of last year. At that time it was assigned responsibility for all phases of systems acquisition, thus placing both the acts of research and development and the acts of procurement and production under a single manager.

Within the Air Force, our systems management philosophy is expressed in a series of regulations which set up and define a concept known as the systems package program.

Systems package programs are designed to insure that systems programs receive continuous attention, over and above the specialized interests of any one functional or organization but still make maximum use of functional capabilities. To achieve this end, offices known as mission staff offices, or MSFO's, have been established at Air Force headquarters. These offices are responsible within the Air Staff for all matters pertaining to so assigned systems. They provide a focal point for Headquarters USAF planning, programming, reporting, and related staff actions.

At the field division level there are offices known as systems program offices or SPO's. The SPO's provide the operating management.

During recent months we have taken a number of specific actions to improve our management procedures. At the top level in AFSC Headquarters we have a Management Improvement Board which is set up specifically to conduct a vigorous program of management improvement. It will provide overall guidance and direction for the command effort in the management field . . .

As another source of improved methods and new policies, an assistant for management has been assigned to each deputy in our headquarters. These assistants for management are responsible for a continuous review of the work in their respective staff areas.

We are making increased use of management teams to conduct reviews of our programs and organizations. These teams are made up of exceptionally well qualified personnel—experienced individuals who are able to make objective evaluations and recommendations.

Management survey teams conduct several types of reviews of programs, facilities, and organizations. They can look at the managing and the functions of an organization, in as far as the two match up. Or they can look at a program as a whole. Our specific area usually excluded is the program survey as it is a matter of system configuration control.

In the past we have had some difficulties in this area, but these difficulties should be largely eliminated as new programs like the Minuteman ICBM program. Now we are concentrating in one command and one office the configuration of each missile and its matching support equipment until it is delivered as combat capable at its launching site.

The contractor reaction to the reorganization of our survey teams has been very encouraging. In one typical instance, a contractor accepted and acted upon 21 recommendations within a 30-day period.

In another act of management, we have adopted a close working relationship with the Air Force Logistics Command. AFSC and AFLC have established a number of joint agreements and regulations, and there is an growing and efficient interface between the two commands.

As you know, we are acting down with industry in specific programs to much the same way. For some of the major systems we have an executive management council composed of the presidents of the participating companies and the commanders of the Air Force activities involved. Because of the ever increasing size and complexity of the management task, we have left the need for a continuing source of professional management control from outside the Air Force.

To meet this need, we proposed—and Headquarters USAF approved—the establishment of a Board of Visitors for AFSC. The board, which is made up of a number of well-known scientific, educational, and industrial leaders, will serve as a source of advice on broad policy matters.

One of the first actions to be conducted by the board is the continuing need to keep industry and the scientific community informed about management developments within the command.

There is a further aspect of management that deserves mention. During the past year we have placed increasing emphasis on the need to reward extraordinary performance by industry with greater profits and with corresponding reductions in profit for lower performance (see page 25). This is part of a concerted DOD effort to make maximum use of the profit method to obtain the objectives of quality, economy, reliability, and maintainability.

In line with the policy of the Department of Defense, a letter has been sent to all Air Force procurement offices stressing the use of contracts based on incentives in lieu of straight fixed price contract as offering the best incentive—both in the interest of the Air Force as well as in industry. Each division of AFSC is now employing and studying greater use of performance, delivery, reliability and cost incentives.

This means that we have to define our job better before we write contracts in order that these incentives will be both meaningful and measurable and that we can go from cost-plus fixed contract to incentive-type contract easier.

It is increasingly clear today that military management does not exist in a vacuum. In the task of systems acquisition, responsibility runs with the award services, but both industry and the scientific community play a major role.

The measure of tomorrow's aerospace strength must be a joint effort . . .



## We put 140 gallons in a 14-gallon bag!

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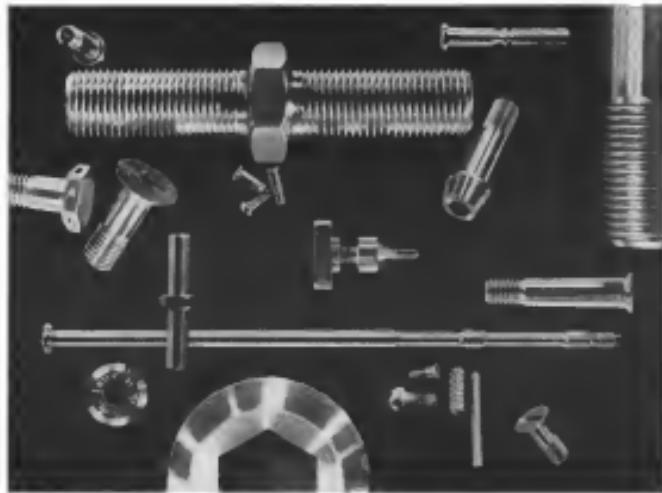
BFG "Estate" can be custom designed to fit irregular enclosures, tankers, aircraft fuel cells, amphibious vehicles, trucks, ground vehicles, light aircraft. Made of Estate, they can be very high tensile strength at high ultimate elongation. Estate has excellent resistance to all fuel acids, various chemicals, and ozone. It will not crystallize when exposed to temperatures as high as 200°F; retains flexibility as low as -60°F.

BFG also offers a line of standard collapsible containers for bulk storage, called "StorageMax". These permanent field storage tanks are hydraulically collapsed and shrunk to a lower cost than most tanks or rigid containers. For complete information on Estate and StorageMax write B.F. Goodrich Aerospace and Defense Products, a division of The B.F. Goodrich Company, Department AF 4B, Akron, Ohio.

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To verify the reliability of its Ti-Titanium aircraft bolts and special parts, SPS maintains a testing laboratory in the research plant where tests of strength properties are run to meet Government specifications and to review production. Random Government inspections are always available.

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## WHO'S WHERE

### In the Front Office

**Elmer F. Whistler**, acting vice president and general manager of a new Space Programs Division of Lockheed Missiles and Space Co., Sunnyvale, Calif. Other top brass: James W. Vassell and Robert C. Gammie. **D. J. Murphy**, general manager, Divisions Division, Houston, the General Services Division, R. F. Borkowski, director of a new Company Planning Staff. A Product Assurance Division has been established in each product division. **W. E. G. Gibson**, director of the Space Systems Division; **D. L. S. Gophen**, in Space Systems Division.

**Thaddeus W. Johnson**, Los Angeles, headed a division of Douglas Aircraft Co. Inc., Santa Monica, Calif.

**Dr. Michael Borkowski**, president of Defense Technology and Processing, with lead quantum in Kolobrzeg, Kennedy, Dr. Borkowski, arrived in chief of West Germany as first research and development.

**Wernher K. Mosler**, president, LTV Electronics Division, President of Technical Division, Defense Electronics, Inc., Research, Miss. **Richard C. Sorenson**, president, Thorolab, a division of Laboratories for Electronics.

**Mr. Patrick Holmes**, board chairman, British West Indian Airways, Ltd.

**J. L. Bannister**, vice president and general manager, Program Management, Space Systems Division, Douglas Aircraft Co., Inc., Santa Monica, Calif.

**John R. O'Donnell**, a vice president, Holloman Electronics Corp., continues as the partner director of government relations. **W. E. Gammie**, director of government relations and **Mr. Gammie**, in Washington, managing director, Holloman Military Products Division. Also **Joseph Serafini**, product manager two gases and **John Serafini**, product group manager, Military Products Division, Loral, Inc., Angelus Oaks, Calif.

**Henry L. Rott, III**, vice president and general manager, a division, Packard Electronics Corp., Pasadena, Calif.

**John H. Carter**, currently vice president of Allied Research Systems, Inc., Boston.

### Honors and Elections

**James V. Reynolds**, director of Sibley Award Program, Director of the National Aeronautics and Space Administration, has been named the 1963 recipient of the Frank G. Bavier Award, which is given annually to the National Aeronautics and Space Administration for an individual or organization which contributes most to the development of research in the field of education and training.

**Walter L. Anderson**, vice president of General Dynamics, Inc., has been elected chairman of the Executive Board of Radio Electronics Products Group, an Electronic Computer.

**E. T. Devlin**, vice president-engineering and product development for Douglas Aircraft Co., has been elected chairman of the Aircraft Technical Committee of the Aerospace Industries Association.

(Continued on page 63)

## INDUSTRY OBSERVER

► Planned inventory of USAF/Douglas Skolite air-launched ballistic missile will not be completed in Boeing B-52B squadrons before mid-1967 at present rate of development funding and projected production. Approximately 1,100 of the missiles will have been produced by that date.

► First titanium to be fabricated by thin film deposition on a non-titanium substrate, anodized-titanium base, requiring a major development in thin-film equipment technology, have been made at Sibley Metalworking Laboratory. Thus far titanium follows closely Sibley's success in depositing thin-film diodes on specially treated ceramic wafers (see charts, see p. 76).

► R. C. Schmid, formerly vice president for engineering, General Dynamics/Convair will become a consultant to Robert R. Glavin, Director of NASA's Manned Spacecraft Center, Houston, Texas. Schmid will advise on engineering and manufacturing aspects of the Apollo development program.

► Certification of fluids for Air Force/Buick Dyna-Seat boost-glide vehicle may not permit inclusion of sensing systems, such as solar cell infrared, in first vehicle for orbital flight scheduled for November, 1964. Fiscal 1963 may see as much as \$20 million trimmed from program's subcontract effort, using as thinking for support equipment which might be used in the program.

► French second stage for ELDO, the European Launcher Development Organization (AW Apr 23, p. 38), will receive an elements of a prototype solid-propellant motor designated Duranc (Diamond) now under development by the French consortium SEARH.

► Proposals for low-observability missile vehicle, incorporating insulation-degrade electromagnetic characteristics, are due the latter part of May at Air Force Space Systems Division. Program is expected to proceed at hardware development. Bidder include Airborne Instruments Lab., Avco, Chrysler, Electronic, Fairchild, General Dynamics, General Electric, General Mills, Lockheed Missiles and Space Co., Martin, North American Aviation and Rockwell Corp. of America.

► Competition for navigation, attitude and checklist of Air Force's Ballistic Systems Division will be concluded by fall. Initial missile program has a May 21 deadline for submission of proposals. Requests for proposals have been sent to 20 industry members.

► Douglas Aircraft has completed design studies of the Rebusa spaceplane and the means for launching from a reusable glider into a circular orbit as part of a private communications satellite system. After NASA evaluates the study in two or three weeks, proposal requests for hardware probably will go to industry.

► Aerospace Plane funded study at General Dynamics/Astronautics is proceeding to get an additional \$1.5 million from USAF.

► Air Force Space Systems Division is considering a program for a reusable satellite system. Dyna-Seat boost glide orbital vehicle fitted with long and short-range solar project for USAF's reusable Space Shuttle satellite suborbital will be proposed by Boeing for the second space reusable orbital inspection role.

► Navy is seeking sources for its initial stock of graduate problems involved in Project Delta. Singing of missiles from flanking installation in the sky. April 10 is closing date for interested firms to notify Navy Purchasing Office in Los Angeles.

► First flight on McDonnell's Project Avant to test hypersonic, lifting re-entry vehicle (AW Feb. 5, p. 50) may be delayed until early 1965 because of program changes and unavailability of Soviet boosters.



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## Washington Roundup

### Anti-Secrecy Moves

National Aerospace and Space Council, whose leaders were instrumental in getting the Pentagon to declassify the geodetic satellite project (see p. 340), is likely to join the effort to loosen the secrecy. Its records changed on military space activities (D&W, Apr. 16, p. 35).

So far the House Government Information Subcommittee has been the only official and steady questioning the wisdom of the Pentagon's secrecy decision. Dick Fleisch, subcommittee chief investigator, went to Cape Canaveral last week to find out how, whenever, government public information officers and scientists there felt about the secrecy order. Subcommittee staff this week plan to discuss the decision with Arthur Shewey, assistant secretary of defense for public affairs and other Pentagon officials.

Secretary order was written by Under Secretary of the Air Force Joseph Clark, and signed by Deputy Secretary of Defense Russell Gelett, after consultation with Secretary of Defense Robert McNamara. The defense staff is secret. The order seems to implement the directive and "They will have to add another line to the Pentagon to implement this one."

Speaker of the House, who sent a memo about secrecy orders to Vice President Lyndon Johnson, is the chairman who participated in efforts to declassify the ANNA geodetic satellite. Dr. Edward Welsh, executive director of the space council who also favored the declassification, kept in touch with the Defense Department since all the ANNA project. He feels it is important the "need-to-know" criterion in the Pentagon's decision should be broadened and he is likely to play a quiet but active role in getting the decision reviewed.

### Senate Missile Study

Congress is preparing investigations into missile hardware and their command systems. The Senate Armed Services Investigations Subcommittee will hold hearings probably late this month on atomic shell on missile warheads, earth warning systems and missile command and control problems. Initial witnesses will be from the Defense Department, but industry source specificity may be called here. A House space subcommittee is considering hearings to explore the causes for delays in the Centaur program (see p. 35).

Major Lt. Col. John Gleas, Jr., at the Third Annual International Space Conference in Washington this week is expected to meet one of his forthcoming guests from Russia. Major Gleas, Vice-chairman Soviet committee to help the earth, which men are slated to participate in the conference sponsored by the Committee on Space Research.

### Non-Profit Investigation

House Armed Services Investigations Subcommittee is shifting the focus of its probe of non-profit organizations to seek possible "break下来s" in the Naval and Marine corporations.

Review is that the Budget Bureau staff of non-profits—already sent to President Kennedy—will continue with the use of such sources, engineering firms in the Aerospace Corp. but besides will look on the property of past research contractors.

In the aerospace branch, expected to start late in May, Subcommittee Chairman Edward Eckstein will concentrate on trying to determine whether the armed services and defense Department are delegating their decision-making responsibilities to various contractors or think contracts with non-profit firms.

### Supplemental Airlines

Financial future of supplemental airlines is being discussed both by Military Air Transport Service command actions and by the general refusal of House committees to grant the lines anything but temporary, individualized authority in pending legislation.

MATS, faced of awarding Fiscal 1965 cargo contracts to the lowest airline bidder, is quietly negotiating most of them. The cargo contracts will total about \$75 million in Fiscal 1965, compared with \$31 million in Fiscal 1962.

Chairman Mike Monrue of the Senate Airlines Subcommittee will try to look the response among Senate-House conference on the vehicle difficult task in preparing that a kind person of the supplemental airline's business be uniformly regulated. He has tried to get House agreement on 95%, but could not even get agreement for 20%. So the compromise to be proposed in the next few days probably will entail a figure under 20%.

Space Age note: Only hold on the Saturn C-1 launch last week lasted 30 days and was caused by a blaster which caused all the warning signals and thermal death under the flight path.

—Washington Staff

# Defense to Stress Incentive, Competition

Procurement economy drive includes heavy emphasis on reward or penalty contracts, long-range planning

By George C. Wilson

Washington—Defense procurement officials have mapped an ambitious economy campaign for the coming fiscal year featuring the broadest use yet of incentive contracts as well as a series of actions designed to increase cost savings among military contractors.

Key elements in the overall strategy are more emphasis on the reward or penalty approach in writing Defense contracts in the first place and closer administration of the work after it is started to determine if economies can be introduced along the way.

The incentive-type contracts will pay out bonuses and penalties for both cost and performance of the finished product. Col. George C. Brummitt, deputy assistant secretary of defense for procurement, told *AVIATION WEEK* that the Kennedy Administration's decision to broaden the use of incentive contracts has been proved sound by recent experience and that "there are here to stay." He said the incentive contracts will be written for the development of the mobile medium-range ballistic missile as well as other major programs (AWP Apr. 3, '68).

The program to incentive competition includes placing some further ahead and in greater detail to support other than the price contracts will be in a position to bid the contracts on the basis of the lowest cost plus by the time the prototype weapon is delivered. Another procedure being implemented is a continuous review of contracts destined for price contracts to make sure the work could not be awarded through competitive bidding.

At present, Defense officials are taking steps to passivate the incentive contracts they feel are as essential to their economy programs. Thomas D. Morris, assistant secretary of defense for research and development, said in a recent interview before the House Appropriations Defense Subcommittee: "We consider the sound and lawful use of incentive contracts to be our top opportunity today for stronger control over procurement costs."

But the U. S. Tax Court Jan. 10 issued a lengthy ruling about incentive contracts by matching profit against cost in deciding that the Boeing Airplane Co. in 1952 made excessive profits on the B-57 contract. Of Boeing's 1952 profits, 68.5% came from work performed under incentive contracts. William M. Allen, Boeing president, said the court's ruling "should seriously undermine the acceptance of such incentive contracts" (AWP Feb. 19, '68).

Subsequently, attorneys for both Boeing and Lockheed Aircraft Corp.

has not been used by the Defense Department since 1954. Morris, in his affidavit, said Defense will "discontinue virtually all" of the fixed-price non-incentive contracts when the price is set after the work is completed. He further said Defense plans to "substantially reduce" the use of cost-plus fixed fee contracts by continuing them primarily to research studies where objectives cannot be clearly defined.

Another effort to curb incentives fears about incentive contracts came April 17 when Chairman Lawrence T. Hiltner of the Recognition Board issued a statement disclosing the Recognition Board does not support the use of such contracts. It said it regards the "allowable reservation" he tries to demonstrate difficulty when deciding whether a contractor's profits were excessive.

Regardless of any industry doubts raised by the Boeing decision, Defense plans to write more incentive contracts in fiscal 1969 than ever before. "We don't anticipate any turn down," Brummitt said. He added that "there is almost no contract that cannot be costed and be some kind of incentive arrangement." Even about the Recognition Board taking away the contractors' weapons under incentive contracts "we are not sure and always have been somewhat" he said.

The Board had now "brought in" and is trying people in the technique of negotiating incentive contracts. He said the Defense Department soon will establish a special school for that for procurement officials in all three services.

Industry, too, will have to intensify its own efforts to meet the demands imposed by the complex, incentive-type contracts Defense will write. One likely cost result, Brummitt said, is a resolution in many defense procurement systems which are not now designed to handle the details of such contracts.

There are several types of incentive contracts, ranging from fixing a price and letting the contractor share in any savings to an agreement providing a award for superior performance of the delivered product. One type of incentive performance likely to move into wide use is the one the Navy awarded to *Grumman Aircraft Engineering Corp.* in fiscal 1968 to develop the AF2/F Intruder aircraft. The contract set a maximum fee of \$55 million, or 4% of the target cost, and a minimum fee of \$19.9 million, or 15% of the cost. The target fee of \$31.5 million, or 8% of the cost, was also set.

Factors for determining the fee were standard for certain aircraft, and based on aircraft performance and cost third

for equipment performance. Aircraft performance was further broken down into three segments, each of equal value weight empty, maximum speed, stall speed, takeoff distance, sustained rate of climb, and maneuverability. Equipment performance was broken down into two incentive paths for navigation and visibility reliability, each weighing one-half for two specific types of boats. The maximum fee of 15% is far above the average for paid contractors on main battle-type contracts.

Industry spokesman long have demanded the principle of incentive contracts, but have conceded the difficulties in setting down specifics for measuring performance, especially on development projects. Panel 1965 will be the most recent test of this type of contracting.

As for incentive competitive procurement, Morris believes that reference to awards will always be made will be a major improvement. "You often will have found ourselves in a sole source position because of the failure to develop, at time, a procurement package that would allow us to issue a competitive procurement," he said recently. "In those cases we have had an alternative other than to buy from a single company. Unless we anticipate the date on which the procurement package will be needed to support a competitive procurement, we will continue to encounter situations where we are forced to take source not by choice but by law."

Steps provided by Defense to cover the intricacies include complex design and specification early enough to start competition when the production phase is reached, ordering a minimum number of spares and components from the prime contractor at the outset of a project so other suppliers will have an opportunity to fill later requirements, and a more thorough review of all pre-contract requirements—particularly by employing more computing equipment. The schematic of new contracts can be placed through competitive bidding.

Other steps proposed by Morris to encourage "true competition" and a reduction in price cost. He said each service has been directed to eliminate specifications for items bought in large quantities to set if they can be built more cheaply.

The effort to reduce paperwork is being spearheaded by the Air Force and Aerospace Industries Assn. Recently, their recommendations call for the reporting requirements to be specified on the contract so the contractor is not called upon unexpectedly to furnish time-consuming reports to military procurement officials.

Defense Department is expected to adopt the Air Force-AIA recommendations in a similar plan.

## Army Requests STOL Transport Proposals

Army requests for quotations went out last week for a twin-turboprop, short-field transport with a payload in the 12,000-lb class after Defense rejected a noncompetitive procurement of the Canadair or Heinkel Canadair 2 for the mission. Proposals are due in 30 days.

Development of the *YUH-1C/C* Chinook helicopter having a cabin and a payload similar to the piston-powered *UH-1C/C* Chinook in the Army inventory is to lead to a fixed-wing aircraft, to remain competitive, would require greater cost and performance.

To meet these requirements the Chinook 2 was designed, with two General Electric T64-1000 engines as powerplants.

However, the new engine and larger fuselage envelope and ensuing changes would be implemented as a new airplane.

At the Army acquisition with Heinkel, the Chinook 2 was selected P-27. This would include double slotted flaps, which have been first tested by *Fokker* on an F-27, other airframe mods and larger fixed gear landing gear. Powerplants would be either the Lycoming T53 or the General Electric T64 engine.

To meet cost saving requirements, Heinkel would provide the existing engine, major configurations, but undercut the fuselage beneath the mid-fairing of chin fixed slats.

The horizontal stabilizer would be modified to a more vertical for increasing lift speed reduced.

**Cosmos 4 was launched two days later. This is the first time USSR has orbited two satellites in such a brief time.**

**Sputnik 7 and 8 were launched during an eight-day interval on February 1968.**

**Two and Cosmos 3 is orbiting at an inclination of 45 deg. 79 min. to begin the slippage of 68.68 and 44.49. Orbital period is 93.5 min. Inclination for Cosmos 4 is 65 deg. apogee is 200 km., and perigee 186 km. Period is 96.6 min. In inclination indicates a different launch point than the first two Cosmos satellites.**

**Cosmos 4 and 5 are in orbit. The satellites will study weather, communications and the effects of radiation on man during prolonged space flights. Because of the unusual frequency of the launches, and the fact that the satellites will be in the same orbit, it is likely that the payloads could be swapped between the two satellites, and possibly television cameras.**

**Cosmos 1 was launched April 14, and**

## U.S. Begins Atmospheric Nuclear Tests

Washington—United States began its series of atmospheric nuclear weapon tests April 24 with the detonation of an unyielded device with a yield in the intermediate range. The first explosion of Operation Dominic took place near Christmas Island, 1,300 mi. east of Honolulu.

Most of the nuclear weapons in the U.S. military inventory will be tested at their operational configuration during this series, and test data leading to new and more efficient weapons employing yields other than blast, heat and particle radiation will be freely published in *AVIATION WEEK* (AWP May 15, '68).

The possibility that the test might blow black smoke into the air was raised in a Federal Aviation Agency memorandum April 13 that communications and navigation aids were expected to be affected if test operations were conducted in the Johnston Islands area.

U.S. and foreign airlines were briefed on special procedures to use in the event that smoke streams were lost. They were warned that Loran coverage might be affected, along with other navigational aids.

Effective April 18 until further notice, the U.S. established a testing area centered on Johnston Island extending to a radius of 478 mi. out at the surface and expanding upwards to a radius of 780 mi. up to 30,000 ft. and above. No radiation or other hazard was expected outside the testing area.

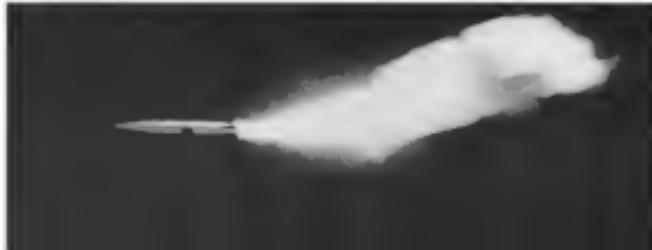


Skybolt falls free of B-52G launcher during first live drop flight. Unstabilized missile is 39 ft long.

## Skybolt Successfully Air-Launched From B-52G



Ignition, 16 sec, after Skybolt is clear of aircraft. Tail cone is blown off from missile, which is in a flight nose down attitude.



Skybolt pulls away from launch aircraft tailcone rising up into tailcone trajectory. Second stage did not ignite.

First drop launching of the Air Force Skybolt air-launched ballistic missile was made by a Boeing B-52G bomber aircraft from Cape Canaveral down the Atlantic Missile Range Apr. 19. Solid propellant motor is made by Aerojet-General, the guidance by North American and the aircraft compatibility by Boeing. Target date for operational Skybolt missiles is 1964. Nose will be carried by B-52G and B-52H aircraft and nose by the British Avro Vulcan bomber. After release, the Skybolt falls free for two to six seconds to an altitude of 200 to 1,000 ft. During this period, Skybolt will complete the launcher descent to stand-off up to 1,000 m. and has excess range. The last few seconds control flight control, propulsive, staging and nose dive entry of guidance. A pre-launch computer also made by North American has been designed to accommodate nose of the missiles. The B-52s, therefore, will carry two computers and the Vulcan one. Currently, 21 development missiles are programmed for live-launching at about one per month. Launch B-52s take off from Eglin AFB on the Gulf coast of Florida and proceed to the Atlantic Missile Range.



# NASA to Analyze Requirements For Manned Round Trip to Planets

By Irving Stone

**Los Angeles.** Requirements for the first manned round-trip mission to Mars and Venus, proposed for the 1970-1972 time span, will be analyzed in a six-month, \$1,000,000 NASA study for National Aeronautics and Space Administration's Marshall Space Flight Center.

Proposals as the competition for the study were submitted under Preproposal Request No. TP-74-611 at the end of March by eight aerospace industry members. Contract award was scheduled for the end of this month.

The study will not require recommendations for the specific plans to be used in a step-by-step approach, and involving definition of more advanced techniques and vehicles such as new operational concepts, the Saturn C-5 as NASA's sole, and operational reusable engines. The same advances are seen as necessary for supplementing basic exploration beyond the Apollo stage. Successful achievement of the mission probably would involve these conditions:

- Mission duration should be relatively short. Approximately one year at the shortest duration which reasonably can be expected.

- Overall mission profile should be two orbits around the sun, type of maneuver appears to most that approach.

- Close encounter with Mars and/or Venus should occur.

- Mission should serve as a development and training exercise for follow-on goal of manned planetary landing.

- Requirements generally should not exceed substantially the state-of-the-art development for the Apollo mission and, if possible, no fundamentally new requirements should be invited beyond those necessary for the Apollo follow-on.

These three demands apparently can be met using a Czerny model for the mission profile, although no such in-

## 1564. Solid Propulsion

**Report.** Proposals for development of a 1564 cu in solid propellant motor are to go to the contractor next week if the selection for the 1564 cu in motor is canceled. Defense Department plans to award the 1564 cu in motor before proposals are sent out the latter month.

The 1564 cu in motor program will be managed by USAF Systems Command's Space Systems Division. USAF and off cost from National Aeronautics and Space Administration recently completed the final work instrument for the project.

start of the nuclear launch engine or to include an additional nuclear or chemical test series for the test.

- Estimates will be made for the number of astronauts required to carry the mission, the size of the vehicle, the number of vehicles to start the mission, and how the vehicles would assist each other.

- Development plan will be outlined, including requirements for special ground facilities, personnel load, if required, mass, cost and development flights, crew training and data collection.

- Funding plan will be developed for hardware and operations, deriving maximum advantage of developments which already are part of the current space program. Research and development costs for Satsys or Nova vehicles, Apollo capsule, and Navsys engine, etc., will not be included, but appropriate development and procurement costs will be determined.

- "Cone-to-ground" trajectories will be evaluated as a minimum requirement for man flight, and an exact trajectory selected for the mission flight, incorporating realistic launch time variables, injection errors, reentry uncertainties, and related data.

- Scientific aspects of the mission, including scientific payload requirements, will be investigated in detail.

- Life support system, vehicle configuration, environmental protection system, and crew/cargo handling system will be evaluated.

- Guidance and control, internal power supply, and integrated electronic systems will be evaluated.

- Checklist of the most probable anomalies, anomalies will be outlined, together with details on how to cope with these malfunctions.

## Gemini Rockets

Small maneuvering rockets for Gemini program will be used in orbital rendezvous flights to be developed by North American Aviation, Rockwell Division under subcontract to McDonnell Aircraft Corp.

Small mobile liquid propellant engines will be of two sizes and will be used in version combinations to control attitude and project the National Aero and Space Administration's program to its orbital change. It is estimated by 1970 in 1970 or early in 1971.

Engines smaller and chambered are to be used by orbiter and project will probably be in the range intermediate to the larger intermediate-size engines to be developed.

Earth-orbition mode will be studied for direct atmospheric entry, combination of rocket braking and direct atmospheric entry, and establishment of an earth orbit and then return to earth's surface. For an operational aspect involving reentry braking, consideration will be given to the advisability of in-

# DOD Stressing Cost Overrun Reductions

By Russell Hawkes

Los Angeles—Defense Department plans two additional, significant changes in military procurement and cost and budgeting. General J. Hatch, assistant secretary of defense, told an aerospace industry group here: These will be:

- Change orders that would increase procurement costs more than 200 million a year, \$21 million for defense of the program will be made only by the Secretary of Defense.

- Defense Department will begin fall, funding all procurement programs as Fund 2064, with the exception of some Air Force excess programs. Fall funding at the expense of requesting Congress to postpone at some time, all the money needed for a program.

Both steps are outgrowths of DOD's continuing attempt to reduce cost increases and to obtain a more realistic picture of total program costs.

Hatch said that program budgeting, one of three basic program budgeting practices, is not used, will be discontinued. Hatch claimed that cost reduction is not a major part of this single-for-cost notion. New reporting levels will be provided as an effort to fix responsibility on individuals for changes.

Fall funding, however, driving probably from Congress to the states, will report more statistics, changes to become efficient. Present budget categories, for example, are to be eliminated.

Hatch revealed the changes in response to questions at the meeting, which was sponsored by the Institute of Aeronautical Sciences before its annual meeting. Defense Department officials had been invited to keep them informed of what DOD's single program paradigm to apply the services in one step. He said the new approach tends to add cost and unnecessary bureaucracy by using other means to achieve the same goals that he had in his speech.

There has been a progressive blurring of the traditional lines of demarcation between the respective roles of the

## Polaris Successor

A new research and development program seeking an advanced land-based missile as a successor to Polaris has been started by Defense Department, awarding to Assistant Defense Secretary Charles J. Hatch. He said the exact type of weapon system has not been selected and the program is, as yet, a relatively small study project.

Defense Department—especially in the ranks of those who must make the basic decisions as the head of the defense of the defense program. This need toward independence will continue in the future. The dependence of the Army on tactical air support by the Air Force is but one of the more obvious examples of the need for an overall Defense Department approach to the direction of aerospace planning.

Similarly, the aerospace procurement efforts to have balanced force ready and equipped to fight the same levels of war need to be made only by the Secretary of Defense.

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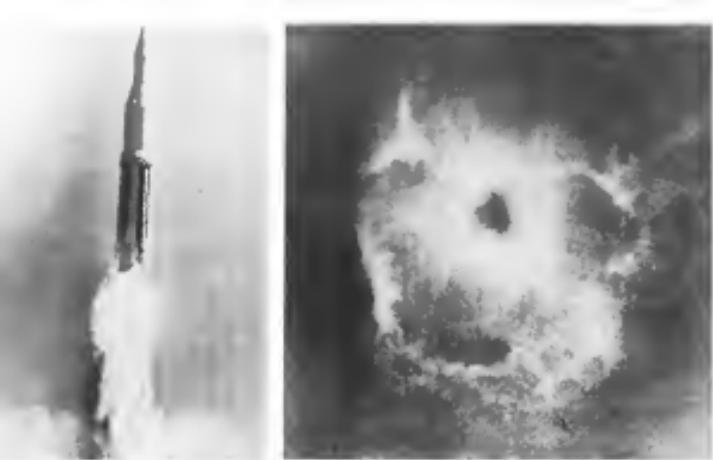
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Nike Zeus Tested

Double step mobile test stand of Army's Werner Electric Nike Zeus solid-ICBM site is visible in the mid section. On the front of the test stand vertical inclusion along the previously suspended 11th launch over the Pacific Missile Range from Ft. Mags. Calif., Apr. 18. Generator steps top but boundary lines to prevent it from being the lowest section of the missile. Appliance for the test stand is a stepped test stand for mobile testing. Second and third stage of the launcher may come from an inventory power unit solid propellant gas generator in the nose. Missile was destroyed after apparently deviating from planned trajectory at latter stages of the flight.



SECOND SATURN C-1 30s lift off in successful shot last week. The cloud, instead of 65 sec altitude, was visible 12 sec.

## Saturn Flight Spurs Manned Shot Plans

Washington—Plans are being made to fly an Apollo 10 manned Apollo-type payload on a second Saturn C-1 launch within the next month. The second launch will be the C-1 booster less seven from the Atlantic Missile Range.

The booster, called SA-1, was launched at 9:30 a.m. April 25 from Complex 34. It was destroyed deliberately 162 sec later, and stayed about 55 sec of motor fire at its cluster upper stage, demonstrating the fast-boost-and-thrustdown in space. The white-colored test article flares which were visible breasted at the launch site. The available ejection formation which permitted was being specially analyzed but had no weak points.

First Apollo-type demonstration flight—SA-2—will be carried on the fifth C-1 test configuration, designated SA-5, which also will be the first Saturn to have a live second stage and the first to have four for acceleration stability. If the development program continues to be as successful as it has so far, a manned Apollo module will be placed in the second Saturn's flight vehicle, the first to be produced entirely by industry.

Two-stage C-1 Saturns will be capable of boosting 30,000 lb into an earth orbit.

National Aeronautics and Space Administration Marshall Space Flight

Center, which developed the Saturn booster, is calling the first 10 flights "valuable to be used in the development program." Chrysler Corp. will fabricate and assemble the operational booster at NASA's Michoud, La., plant.

Results of SA-2 were largely a repeat of the completely successful SA-1 flight on March 29 (AW No. 6, p. 30). Preliminary medium-thrust test in boost engines cut off 118 sec after flight, and onboard engines cut off at 161 sec after flight, with a maximum thrust of 13,000 lb. In Detroit, it turned a 90° at altitude, which is the point of entry of the Paragon in the main capsule. Telemetry data of interest was measured accurately.

Antiblock brakes were tested on the lower rail of the ejection tanks in the booster to correct a major instability problem experienced during the final stages of powered flight in SA-1.

Other changes in SA-2 from the first flight test booster were addition of a smooth tilt program, and addition of sensors for seismic, vibration and heat measurements.

The smooth tilt program was operated, working from T+10 to T+100 sec to raise the rocket to an angle of 45 deg. In SA-1, a motor was used to command tilt, which resulted in a parking motion every 10 sec.

The smooth tilt platform was tested in the guidance and control system to prove attitude and acceleration measurements. This is the same stable platform developed for the Regulus missile. Also on SA-2 was the Paragon stable platform, ST-124, which will become the operational platform on the C-1 configuration, beginning with SA-5 or 6.

The 162-ft SA-2 vehicle weighed 927,000 lb at liftoff, which included 830,000 lb of propellant and 190,000 lb of water in the dummy S-1 and S-5 stages. The payload was a Jupiter nose section, which weighed about 3,000 lb.

These were the vehicle development objectives of the flight, all of which were achieved.

▲ **Assess flight performance** of the

### S-4 Static Test Plans

Washington—First static test of the Douglas S-4 Somes second stage has been scheduled for late May, and if the ground test program is successful the engine will be flown with the SA-5 Saturn developmental vehicle in July 1963.

The S-4-2 engine will be powered by Frost & Whitney RL-10-A3 nozzles and has been under development by Douglas about two years.

Boeing is working the first 10 flights to demonstrate the feasibility of the second stage of the Saturn C-1. The second stage will be the C-1 booster less seven from the Atlantic Missile Range.

The second stage will be the first to have a live second stage and the first to have four for acceleration stability. If the development program continues to be as successful as it has so far, a manned Apollo module will be placed in the second Saturn's flight vehicle, the first to be produced entirely by industry.

Two-stage C-1 Saturns will be capable of boosting 30,000 lb into an earth orbit.

National Aeronautics and Space Administration Marshall Space Flight

### New Centaur Delay

Washington—After Centaur launch was held, when the test has been delayed for more because of malfunctions in ground support equipment, we are still about April 21. The Centaur engine burned 3.5 sec, and then shut down because the Atlas lower umbilical probe failed to disconnect. Major held in the launch a new cause by closure of the Atlantic Missile Range, and very little in other work. The vehicle itself is considered ready for flight.

In the latest postponement, the booster spent an additional but the mal-functioned electrical equipment failed to operate. This interrupted the hold cause engine and caused an automatic engine cutoff. Attempt to launch Centaur I April 20 was ended when a disk ruptured in the liquid oxygen loading system.

Attempt to launch the second April 21 was ended when liquid oxygen pressure was too low in the Atlas stage. It was larger transients exhibited in the gage was too low, giving a false indication of low pressure.

Eight Rocketdyne H-1 engines in the booster cluster, the controlling movements of the four parallel engines and engine cutoff and propellant utilization. The engines developed about 165,000 lb of thrust each. Projected cost was about \$10,000 lb. □ For more information, see "Centaur," p. 30.

### Vehicle Demonstration

▲ **Qualify the Complex 14 launch vehicle**, together with propellant supply, ground support, automatic checkout and retropropulsion systems.

The SA-2, which contained 930,000 lb of propellant, 310 of these dealing with flight performance, also flight. Another 15 measurements were made of seismic, vibration and blast around the launch site and up to distances of 10 miles from the pad.

The second stage platform, called Project 10, was developed by the Douglas Co. for NASA Space Services. Other to determine the effect of a large mass of water on lower atmospheric dispersion of the noise field, but this took only about three times longer than was anticipated. The cloud was visible from the ground for about 12 sec, and apparently consisted of an which passed with 10 sec. The ice cloud was tracked by radar and apparently traveled at a higher rate than the motion of the booster and vehicle. Trackers observed an electric discharge phenomena much to the great joy of a thousand.

The S-5 stage, a cluster of two RL-10 engines, is under development by General Dynamics/Aerospace. It is a much bulkier Centaur stage to be used when escape missions are assigned to the C-1. □

## Senate Committee Is Told of Plans For Telstar Television Experiments

By Katherine Johnson

Washington—Plans for three experimental television transmission via American Telephone & Telegraph Co.'s Telstar satellite were outlined to a Senate committee last week by U.S. Information Agency Director Edward R. Mead, Jr., at Congress' call toward enactment of legislation authorizing a private corporation to develop and operate a communications satellite system.

The House is scheduled to start consideration of the legislation on the floor May 1. The measure was originally proposed by the House communications committee to consolidate the three existing satellite systems under the Senate space committee (AW Apr. 2, p. 30).

It provides for licensing the corporation with an 80% share of stock, 50% is needed for ownership by communications common carriers and 50% in the general public, selling at a maximum price of \$300 a share.

Senate communications committee, which is considering the measure proposed by the Senate space committee, is expected to send it to the Senate floor for action shortly. Committee committee hearings were completed last week.

Both bills direct the Federal Communications Commission, in making the final determination on the basis of availability in providing licensing by the communications common carriers.

An amendment to eliminate this provision, which will be offered as the House bill by Rep. John Marin (D-Calif.) and Rep. John Dugan (D-Mich.) appears to have a good chance of acceptance.

### Firms Asked to Bid On New OSO Study

Washington—Three-light atmospheric firms have been requested to bid as a team to conduct a study of the resulting networks, and cost estimates for an advanced orbiting solar observation satellite program for National Aeronautics and Space Administration's Goddard Space Flight Center.

Bids will be due May 25 and those in which study partners will be awarded in June. They will lead to precise design criteria for the S-47 interface to be launched in about three years. The satellite will weigh 900,000 lb and should be built by either a Thor or Atlas Agena B.

The first satellite in the series OSM-1, weighs 450 lb. It was launched Mar. 7 and continues to return data from its experiments (AW Mar. 19, p. 29).

## DOD Secrecy Ruling Confuses Industry

Washington-Defence Department last week bowed to pressure generated by senators and congressional organizations which ordered declassification of the ANNA (satellite) satellite project. The demand came due to the confusion generated by a general clause, which originated at the highest level of government, placing a severe clamp on information about military space projects.

The directive stated that all information about ANNA (Air Force, Navy, NASA and Army) could be withheld except for some of the released information. Some of the classified data, however, could not be withheld, and the Defense itself will be made available to the Navy's Bureau of Weapons, which has responsibility for the project.

The space security directive, issued over the signature of Deputy Secretary of Defense Russell Galvin on May 21, has caused confusion and dismay among military information personnel, intelligence agency program directors and, in many administrations, DIA (Air Force) officials who may still be in the government wing.

## British Aircraft Operational Requirements

London-Top-level British military committee is currently meeting here to determine the future of three British aircraft operational requirements, with final report due in the fall, scheduled for early 1982.

Requirements at stake are:

- DR-151, a forward-looking transport for the Royal Air Force. Competitors are the Armstrong Whitworth A30, Bristol 206 and the Short Belfast (AW Mar. 5, p. 20). All are canard-powered versions, with the initial two designed around four Bristol Siddeley BS.53 vectored-thrust engines. Belfast includes Rolls-Royce lift engines for landing.

- DR-152, a medium reconnaissance aircraft to replace the present Shackleton. Avro's Avro is bringing the Shackleton to MR-3 configuration, including a fly-by-wire pitch, and meanwhile is working an company-funded feasibility study to design a replacement, either indigenous or pure jet. Avro two years ago designed an all-rotor transport aircraft, in which one engine would be shut down for takeoff, this project was dropped. In addition, Vickers-Armstrongs reportedly is studying out options on use of its VV 100 jet transport for this role, since British philosophy states no more than two engines when operating at ranges up to 1,600 nm are to be used.

For these reasons, the Budget Atlantic is not considered a top contender. Requirements may call for a twin-jet geometry wing.

- DR-154, a new role fighter involving use of variable geometry. Both Bristol Siddeley advanced projects team and British Aircraft Corp. are working on the requirement.

Check out the operation and launch the system.

Fighter procurement unit—which can deliver finished products or negotiate from the draw's outset—will plan extra fuel and spare parts made up a load for another part of use. The draw is to be hand off flight photographs showing ordnance, gun emplacements and other details.

The first effort of the development was to seek a military need for a simple, lightweight reconnaissance vehicle that can operate over short distances, return remains in maximum hours and be operated by a minimum number of ground personnel.

Other uses proposed for the draw include possible revitalization of a role at the aerial and ground camera instead of the aerial still photo camera, or target and ship of aerial and other targets.

Mariah Corp. and Army personnel watched the demonstration at the Quantico Marine Corps Air Station.

## N-156 to Replace Allies' F-84s

Northrop N-156 has been adopted by Defense Department as standard fighter to be supplied to smaller allied air forces under the Military Assistance Program as replacement for obsolescent Republic F-84G still in use.

The announcement marked the end of a contentious Defense Department-International Security Affairs Agency, concerning the N-156 and USAF, urging selection of the Lockheed F-104G (AW Mar. 19, p. 28). Final USAF budget requests included funding for a Military Assistance Program standard fighter. Defense is to begin 14 months after purchase.

Size of the initial order is not yet known but the total may be expected to be 180 or 200 aircraft. They will be substantially consolidated from the test version now flying. Northrop proposed an "optimal version" without the control surfaces of all-weather capability, but these are likely to be retained to suit customers with different levels of technology. The defense supplier are to have seven external stores stations rather than five as on the test aircraft.

## Emphasis Shifts to Venus Probe After Disappointing Ranger Flight

U.S. lunar planetary program will shift to Venus following the flight of the Ranger flight last month, which failed to achieve its primary objective of providing closeup pictures of the surface and data on the composition of its surface. Two Mariner B payloads will be launched in the July-August period in attempts to fly to Venus. Ranger 3, launched just 28, failed to achieve its objective when the Atlas booster burned 1.5 sec too long because the guidance system failed to provide the shutdown signal (AW Mar. 5, p. 18). Instead of impacting the surface, it entered at 22,000 m/s and is now in a solar orbit.

After Augus 8 will be the workload of heavy duty NASA engineers until Centaur becomes available, and James E. Webb, NASA administrator, said after the Ranger 4 flight that his agency has five months with Lockheed for 30 Augus 8 flights.

The Mariner B Atlas Augus 8 vehicle will be similar to the vehicle for Augus 4. One major difference will be the inclusion of a thermal insulation, which will be obtained about a planned one-month overflight surrounding the moon when all types are analyzed. But this is the only scientific information expected from the complex payload.

Although Augus 4 was the first U.S. payload to impact the moon in 10 attempts, the stability of the payload to perform its scientific mission was a bitter disappointment. Previous data indicated the payload orbital computer and sequencer failed when the payload was over America. Based on the new Augus 4 data, the payload was in a parking orbit. The twin Pulsar Velocityometers did not work, but the sequencer reported good signals and the failure was reported by the mobility status from Commanding, South Africa.

Proton handling was considered for the first two flights of Augus 4 by use of a two-tier payload system, which provided both range and angular rate. Spacelab batteries went dead after one hour because the solar cell array apparently failed to deploy, and tracking from the payload provided only angular data. The payload was tracked by signals from the 90 nm transmitter, operating at a frequency of 960 nm, in the final tracking segment.

At the time of the Augus 4 impact, Ranger 4 was 166 m above the lunar surface. It then back-tocked toward the surface and impacted near the edge.

Impact itself without maneuver and thermal protection was considered a

## UK-1 Launch Succeeds

U.S. successfully orbited an amateur package containing a variety of amateur measurement instruments developed by British universities. The satellite, designated UK-1, was launched at 1 p.m. April 26 by a Delta vehicle, the eighth successive successful launch by the Douglas-developed rocket from the Atlantic Missile Range.

At Point Mugu Naval Air Forces launched two satellites April 25, one carried by a Blue Bird rocket and the other by a Delta. Both the payloads were successful, but the payload on the Blue Bird, an Agus 8, failed to provide the shutdown signal (AW Mar. 5, p. 18). Instead of impacting the surface, it entered at 22,000 m/s and is now in a solar orbit.

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success of Britain's UK-1 satellite. The satellite, designated UK-1, was launched at 1 p.m. April 26 by a Delta vehicle, the eighth successive successful launch by the Douglas-developed rocket from the Atlantic Missile Range.

The UK-1's UK-1 satellite was selected to be reported on a 280-km orbital, and early telemetry after the first orbit indicated that the payload and payload were in planned

Apogee-Ground will be under 54 million ft-lb. Force, below-orbit research equipment will use large load payload rocket system consisting of two 180-lb-in diameter fire Avon 500s, and two 44-lb-in diameter 1/2-in of the new fire-coupling Avon 500s—an unlaunched for hot work. Apogee ground will be used for 180-lb diameter under previous contract to the Air Force.

Crash of Britain's UK-1 satellite, AWG prototype aircraft during a test flight April 19 is not expected to delay seriously production of the NATO project. First prototype still is flying, and third is due to roll out soon. An explosion here the will bring off the rocket aircraft.

Dr. Frederick Sotz has been elected President of the International Space Society, succeeds outgoing Dr. Pedro W. Brook who has served three terms. Sotz, a nuclear physicist, will be the Academy's first full-time president. He is on leave from the University of Wisconsin, where he headed the physics department.

India is negotiating final arrangements for manufacturing the French Sud Aviation 3 helicopter in India. Agreements probably will terminate discussions for American firms to move Indian helicopter units.

Sir Freddie Headley Page 75, chair of Blandford Page, Ltd., died April 13 in London. His death has triggered speculation that his firm may merge with one of the two large British aerospace groups, Hawker Siddeley or British Aircraft Corp.

Progress Report on Washington's International Terminal: Part I

## Dulles Field Caught in Cost, Time Squeeze

Lags in construction of airport to result in token service on Oct. 1, precluded by Federal Aviation Agency Administrator Naper E. Halibut, unless it results in much more token airline service, highly sufficient to justify the elaborate inauguration ceremony now being planned.

The much-needed opening date of Oct. 1, precluded by Federal Aviation Agency Administrator Naper E. Halibut, is unlikely to result in much more token airline service, highly sufficient to justify the elaborate inauguration ceremony now being planned.

The decision will close the planning evolution of the airport which began with a planning session by FAA—the Civil Aeronautics Administration—24 years ago. Congressional approval of the site two years later in 1951 resulted in the purchase of 1,200 acres at a cost of \$4 million for an airport at Dulles, Va. More than a dozen of bitter political debate followed, resulting in abandonment of the Burke Act at a cost of \$400,000 to the taxpayer.

Selection of the present Dulles site by then Administrator Elwood E. Quesada was accompanied by an optimistic prediction that the installation would be finished by mid-1953. That date was later revised to early 1962. As one of his first actions, Halibut, who was highly critical of FAA's handling of the project, set a target date of July 1962 for the opening, only to later extend the goal to October.

Despite surpassing construction programs and continuing negotiations with prospective air carriers, FAA finds

work of the building is finally in place.

FAA is hopeful that it can persuade the contractor to waive the Oct. 1 deadline by increasing work crews or paying overtime, or, ideally, ease the contractor's mind to a reduction of Halibut's and Halibut's profit as the recipient. Should the contractor steadfastly decline to take these steps, all costs will be added into legal be charged in a contractor's claim against FAA, agency sources explain.

From with the Oct. 1 deadline, FAA drivers will consider from the priority provisions of the contract, since an acceleration awarded, or might be forced early by the contractor to extend the completion deadline and pay the penalty that it would to voluntarily increase his work force and hours to meet the deadline.

• **Control tower completion** is about seven weeks behind schedule because of difficulties in obtaining the special gear required to get the tower to the top level of the 17-story high structure. The gear, including the third floor, glass and elevator installation, was originally slated for completion by May 15, but FAA feels that if it is done by early June, there will be sufficient time for installation of electronic equipment necessary for operation in October. Installation of this equipment was to have started by April 1 on a progress chart which shows an estimated six months for completion.

• **Service building group**, to the east of the tower, will house ticket counter, self-service ticket counter, and weather balloon facilities. Construction has been completed on the two-story, 24-unit building, which is to be occupied until the

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• **Terminal building** is to be occupied until the



AERIAL VIEW OF DULLES shows general field layout. Terminal is located at north side of operational area between two north-south runways. Fuel tank is just to right of right hand runway. Approach, runway, taxi and high-speed tunnel lighting is being installed.

initial schedule, but FAA is confident the test time can be picked up to meet the target date.

• **Lighting and taxi installation** in the terminal area has been one month behind, but FAA expects this time to be easily recovered.

On the credit side, FAA reports that more than 90 percent of the project is either completed or on schedule. By May 1, a series of mass-hold orders previously affecting ticket counter and concession space in the main terminal building will have been dissolved. Construction is already under way on the west jet open operational building necessary to begin service and contracts will soon be let for cargo and warehouse buildings and a utility loop to serve the build and industrial zone plus to be located just north of the terminal.

After much a year of political debate, and four years of construction, hope is what FAA is offering at what it officially calls Washington International Airport and Dulles Terminal.

• **A 9,500-square installation** located 27 miles from downtown Washington, at Chantilly, Va., will serve by Oct. 17 as a high-speed terminal and maintenance base for Dulles' flight fleet.

• **Two control towers** are to be located at the site. One, 100 ft high, will be located at the intersection of the two runways and eight stories for the hub area has been acquired. The remaining segment is to connect with Dulles' Highway 66 planned for future construction by the State of Virginia. The third tower site will be located at 100 ft from the runway and eight stories for the hub area has been acquired.

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• **Terminal building** is to be occupied until the

• **Local buildings**, garages will with less than 100 ft from the main entrance to ticket counter, baggage claim counter, and fuel storage tank is to be completed to prevent optimum within four months.

FAA engineers, however, are the site have greatly enhanced four months as sufficient time to complete the work. Then the port will be that the first finished spans buildings will be available to American and Eastern Airlines on the west end of the span.

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VIEW OF TERMINAL FROM OPERATIONAL AREA, left, shows 175-ft high control tower connected to terminal by 200-ft long finger. Local service space is in front of tower. Airport's concourse of terminal interior, right, shows ticket counters near entrance.



AVIATION WEEK and SPACE TECHNOLOGY, April 26, 1962



## Trans World Receives First 707-131B

First of 30 Boeing 707-131B medium passenger aircraft was delivered to Trans World Airlines recently. The airline will operate the four on domestic routes as "Starstruck" jets. The Boeing 707-131B has a gross weight of approximately 255,000 lb.

### Lockheed Electra and Viscount

However, FAA admits, it cannot be said with the full assurance. Consider because of the inherent risk loading passengers. Commercial passengers will use the vehicle known for most with a short distance to the aircraft.

\* Helicopter operations will be concentrated by four landing pads on a 45-acre plot located between the feeder highway and main airfield operation areas. For the larger V-STOL type aircraft the agency also is providing a 600 ft long landing strip in the area. These aircraft will pick up and discharge passengers on the feeder bus system.

### Main airport operations

Buildings, originally planned to provide 10 parking bays in two buildings, have been expanded recently to provide 15 bays each of 40 ft by 60 ft, and 10 bays each of 60 ft by 60 ft. The cost of each building is held in place to facilitate expansion to a maximum of 90 bays. Four fuel hydrants with a pumping capacity of 2,000 gpm, are located at each bay position. Eight outlets of fuel pumps have been laid to supply the stations from a five million-gallon capacity fuel farm located on the eastern border of the airport.

A 40-ft high airport control tower, to direct the movements of toning aircraft and mobile storage in the areas seen, and an aircraft waste disposal facility, also being constructed. Total construction costs for the airport and facilities are estimated at more than \$12 million.

\* Two parallel north-south runways, 13,500 ft long and 150 ft wide, and a 10,000 ft west-northwest axis south east runway have been completed. Each of the longer runways, separated by

the Potomac River, are equipped with light systems, for which Congress has appropriated \$11 million. Meanwhile, 23 airport sewage will be pumped into the three open concrete ponds located at the northern corner of the airport, adjacent to the eastern paved runway. Water runoff from the ponds will be supplied from a two-million-gallon storage reservoir, under a contract with the Prince County Water Authority.

\* General aviation facilities will be located on a 10-acre plot located northeast of the terminal building. FAA has sent out invitations to bid for private construction and long-term lease of hangar facilities, with a suggested rental fee of 10 cents a square foot annually for a 60,000 square foot hangar. Other general aviation facility lease fees suggested total 40 cents a square foot for open space and 2 cents a square foot for enclosed hangar space.

\* Helicopter facilities, intended aircraft will not be located on the site. This decision is not firm reflection of what they will be done. FAA originally designated that the owners build their own hangars, but selected last year and asked Congress for an additional \$6 million to build one. Forbey personnel systems hangar for lease to the airlines. Congress rejected the request, which has been reduced this year to \$3.4 million.

\* Construction contracts are being signed on a long-term basis permitting FAA to review construction costs and giving the agency clear title to any improvements built by the concessionaire. In addition, terminal and concessionaire contracts extending through 1993 and beyond are EAA contracts. The concessionaire will be responsible for all construction costs at \$10,000 per year. Service buildings which these operators are entering on 40,000 sq ft plots will revert to FAA ownership with termination of the contract.

In a similar instance, the concession for contractors and operators of the Washington International Airport Hotel is under a 90-year contract guaranteeing FAA a minimum return of \$1 million a year and several ownerships of the hotel. Initial contract was for 10 years, but it is expected to start with the ninth year.

Ultimately, it is anticipated that the cost of Delta will exceed \$100 million. The cost of the new terminal buildings are estimated to handle a projected volume of six million passengers by 1975. Under long range expansion plans, the use of the present terminal building would be doubled, the snakes of the airlines' airport operations buildings would be tripled, a lounge building would be added and an industrial complex would be developed along the southern boundary of the installation.

(This is the first of two stories on Dulles Airport. The second will appear in a subsequent issue of AVIATION WEEK.)

## International Airline Traffic Results—1961

Revenue Miles Flown 1960	Revenue Miles Flown 1961	Revenue Passenger Carried 1960	Revenue Passenger Carried 1961	Aircraft Seat Miles Flown 1960		Passenger Seat Miles (1961)
		Domestic	International	Domestic	International	
America	1,201	8,299	4,613	29,837	2,754	39,654
Air Alsop	204	11,784	497	20,012	12,664	7,683
Air France	58,947	29,212	1,000	1,044,714	1,044,714	4,000
Air India	12,924	203	23,311	323	12,924	4,000
Air Italy	5,345	—	4,071	4,074	4,074	44
Air Vietnam	713	1,260	3,408	4,092	29,173	34,071
Air Zaire	12,241	1,260	1,000	1,000	1,000	211
Air Zaire	5716	144,164	4,580	371,944	79,042	1,000
Australia	32,283	—	72,661	120,861	74,203	1,247,470
Airline	6,030	—	12,703	23,101	—	387
Australia & Germany	1,041	8,982	4,429	13,059	2,817	24,720
Airline	4,854	17,675	3,687	6,523	3,687	43,556
British European	42,711	11,174	11,019	40,815	12,879	9,645,315
BIA	5,411	10,000	10,000	10,000	10,000	211
British United	6,233	272	1,000	1,000	1,000	4,000
BAM	1,069	3,038	8,995	14,611	8,994	34,071
CATA	1,031	—	3,883	1,772	—	45,789
Canadian Pacific	13,015	7,064	24,217	30,091	104,664	261,272
ELA	6,646	4,776	13,795	20,343	92,814	180,879
Cobain	2,402	3,175	3,356	4,074	2,143	1,605,747
Copa Eagle	1,459	—	4,123	112	3,149	1,014
Copa	1,638	—	2,648	47,620	—	120,175
Dala	1,283	8,123	7,923	19,119	10,959	34,140
Dala (Macau)	1,611	3,247	3,247	8,297	2,029	10,959
Dala (West Africa)	1,639	—	1,720	1,720	1,720	1,720
Dala	2,837	184,756	22,393	44,774	49,515	50,918
Dall	10,240	—	11,803	1,493	1,493	1,493
Dakota	2,194	1,151	13,971	4,487	4,066	43,172
Dakota	4,007	4,034	11,344	20,239	18,712	103,161
Dakota	7,194	—	17,347	17,347	17,347	47,433
E.A.C. (Gulf)	3,297	39,195	9,194	70,798	21,794	241,937
Dakota	11,121	31,270	26,675	40,704	26,370	78,630
Dakota	3,772	—	3,113	30,963	3,113	3,113
Dakota	1,254	—	1,254	1,254	1,254	1,254
Japan	16,274	71,210	12,344	43,473	16,245	46,976
JAT	2,980	3,485	6,017	12,023	11,803	11,803
JAT	71,123	177	177	177	177	177
JAT	4,049	—	11,288	11,288	11,288	11,288
JAT	16,670	8,348	10,244	20,101	10,000	18,000
JAT	7,074	—	17,281	17,281	17,281	17,281
JAT	10,700	—	17,281	17,281	17,281	17,281
JAT	16,670	8,348	10,244	20,101	10,000	18,000
JAT	7,074	—	17,281	17,281	17,281	17,281
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JAT	10,700	—	17,281	17,281	17,281	17,281
JAT	16,670	8,348	10,244	20,101	10,000	18,000
JAT	7,074	—	17,281	17,281	17,281	1

# CAB Proposes Stronger Control Of Bilateral Capacity Violations

By L. L. Doty

Washington—Civil Aeronautics Board staff is proposing an amendment to bilateral air transport agreements that would authorize government to revoke operating rights of carriers failing to conform with capacity provisions of such agreements.

The proposal is the latest in a series of attempts by the U. S. government, so far, to impose capacity restrictions on foreign flag carriers serving the U. S. It is, however, the first open move toward overriding bilateral pacts that have been made since the U. S. switched from a policy of freedom of skies to one of capacity control.

Introduction of the amendment into agreements now in effect will require participation of the parts with the committee involved. Once the language is proposed, the Board staff proposes to use its tools for amending the Bilateral Air Transport Agreements.

"Should consultations take place between the two governments concerning capacity, and should these consultations not result in signed documents, each government retains the right to modify or revoke the operating permissions with respect to any schedule of an airline of the other party which has harm the safety of the other party which has harm the safety of air carriers, and which that government believed might not be open and in conformity with the express principles of the agreement. In that event, action to modify or revoke an operating permission would not be subject to arbitration in accordance with

Article 15 of the Air Transport Agreement."

Originally, it was planned to confine this terminology into the bilateral agreement with Australia, but following the U. S. and that nation were annexed before the subject of capacity was raised (AW Apr. 23, p. 151). The proposed amendment is also similar to wording used in the recent exchange of notes with India on the capacity issue.

Principle purpose of the amendment appears to be to provide the U. S. with some form of capacity control without the necessity of going into arbitration. In the past, arbitration has been easily avoided by all nations because it provides an guarantee that a nation's goal can be achieved.

## Excess Services

Under the terms of the Bilateral Air Transport Agreement, either party to the pact may ask for a revision in the capacity when it is felt that an air carrier is operating services in excess of that provided by the agreement. In 1966, the U. S. attempted to impose restrictions on Scandinavian Airlines System schedules to and from the U. S. through the process of consultation (AW Oct. 10, 1966, p. 42).

This attempt failed because the Scandinavian refused to submit traffic data sought by the U. S. and, in the words of one CAB official, because of "changes in the principles involved and a failure on the part of the Scandinavian government to impose SAS to other air

carriers of operation—or even to agree not to further expand its services which the U. S. already believed to be excessive and unsatisfied."

When consultation fails, governments are left with two alternative determinations of the bilateral agreement or arbitration. Neither course was chosen in the SAS case and the dispute with the Scandinavians, and with a number of other nations as well, continues.

## Political Implications

Demonstrative of agreement is likely to be followed upon by the U. S. government CAB Chairman Alan S. Revel recently and "Here we have the field of aviation and pick up the problems of political relations which directly concern us. We have to take into account the political situation in the area." Revel said and "We are still very strong allies in the Atlantic." The cause of this is traced to the rise of Hitler.

Both IATA and SAS have been chief targets of U. S. accusations of bilateral agreement capacity violations.

State Department will not condone any unilateral action against any country with which the U. S. has a bilateral agreement. As a result, it is not likely to back any attempt at diminution.

For the same reason, it may not be possible across the CAB table to avoid a change in carrier status as a means of restricting capacity, in the event the Board should decide that such action is in the public interest.

U. S. capacity controls may be applied to carriers not in the SAS alliance and not in the IATA pact to a state or states which it is felt "require such action and might otherwise circumvent" if other measures failed.

## Arbitration Procedure

Arbitration by a tribunal consisting of one representative of each of the two nations and a third representative chosen in the two host governments is permitted under the terms of the agreement, as is transport agreement. No carrier may be compelled to arbitrate in a manner differing from its own nation—namely France and the Philippines—have demanded or threatened to postpone their bilateral with the U. S.

A number of government attorneys interpret U. S. law as preventing the government from enacting anti-binding arbitration, and that fact that arbitration under the provisions of a bilateral agreement is a potential action.

As a result, the proposed amendment to the Bilateral Air Transport Agreement is designed to allow the consultation process and to prevent the enforcement of capacity restrictions without the threat of arbitration. The revised language applies only to as part fails or revokes of capacity issues raised in consultation.

# Controllers Protesting Punishment Imposed by FAA in Traffic Error

Washington—Punishment proposed by Federal Aviation Agency for the controllers who held traffic and over the course of 10 hours caused altitude for 750 aircraft to exceed 450 feet above or below 400 ft. of each other and 5750 minutes following major aircraft flight plan.

The safety publication incident, which occurred on Mar. 21, involved a United Air Lines Vickers and an Eastern Air Lines Electra. Both crashed at 7,000 ft. in a 1,000-foot holding pattern over Springfield, Mo., while enroute clearance had to land at Washington National Airport.

FAA has and it will transfer the responsible controller to "a less demanding" location and job, that reducing his rank from a GS government service level of 12 to 9. But according to FAA Administrator N. E. Hulsey, because the ATC system is suffering from a 15 percent of backlog, the agency could not generate the needed controller.

Commenting on the cause of the accident, Edward H. Goddard, executive director of the Air Traffic Control Assoc. and last week.

"Let's say that a man suffered a temporary lapse under the stress and strain of his job. It is an act of care and caution for those unfortunate enough to become involved in such accidents as the one. But such acts increase the stress and strain on those individuals engaged in this activity, knowing that with one slip of the tongue they can lose their means of making a living for their families."

An Aviation Writers Association of controllers, the Washington tower and center indicated that most controllers would be assigned to the most difficult towers and centers in the U. S. As a result controllers had for prolonged assignments on the basis of their GS level, security and the responsibilities attached to the position.

## PanAm to Purchase 2 Boeing 707-321Cs

New York—Pan American World Airways will purchase two Boeing 707-321Cs for \$100 million each for 1967 delivery and a price of \$15 million.

The 707, convertible to passenger or combination passenger-cargo configuration, will have the same basic airframe and dimensions of the 727, turboprop passenger aircraft, one of which recently was received by Pan Am. Modification made the cargo door located forward of the wing on the left side of the aircraft, and located on top of the aircraft. Maximum gross weight of the 727 will be 327,000 lb., compared with 317,500 for the 737.

■ What sets the aircraft apart from other aircraft is that each side of the aircraft system. Features furnished

Complaint for cargo jet orders is leveled to the Boeing plan, the Douglas DC-10, SP-Trade convertible aircraft, and the L-1011, and designation of the Lockheed C-141 cargo jet ordered by the Air Force. Douglas Aircraft has ordered 10 DC-10s. The L-1011, intended for military and civil use, is not expected to be available for airline operation before 1966.

Pan Am's 737s will be powered by Pratt & Whitney JT3D-1 turboprop engines and maximum cargo payload is 50,000 lb.

The jets will replace Pan Am's "Art Park" jetliners, including various aircraft and 15 aircraft instead of the seven currently used in DC-10's future freighter operation.

Boeing said last week that it has at least one additional order close to the signing stage, and when it is prospect, the next customer, Boeing said, has a delivery corner.

## Examiner Ruling Due On Northeast Control

Washington—Civil Aeronautics Board examiner's decision in the Hughes Tool Northeast Control Case is expected this week or early next week.

In his decision Examiner Merritt Rabkin will have to approve or disapprove Hughes Tool's application to extend the rules. Rules is the exam user-defined procedure step before the initial determination due Apr. 30 (AW Apr. 24, p. 42).

The examiner's decision would become the decision of the Board 10 days after it was issued if no appeal had been taken. However, in view of the strong position taken by the parties in the case, it is expected that no appeal for review will be filed regardless of how the examiner rules.

In this case, petition for rules will probably mean that the case will have to go before the Board for decision. Estimate of when the Board will give the case center around June 1.

Hughes has a rule it will have sufficient rule on hand by June 10, date opening argument after May 15, but that does not allow Northeast tool had a way to continue operations until the Board rules on final decision.

During the last part of the final week of the hearing, most issues were closed to relevance while Hughes Tool Co. general discussions required a CAB Bureau Control Panel Session. Hughes Tool's attorney, Clinton Davis, and he separated the closed procedure to prevent any damage calculation from getting into the hands of adverse parties in the current litigation with Trans World Airlines (AW Feb. 19, p. 47). The hearing ended on Apr. 20.

## FAA Development Chief Appointed

Washington—Federal Aviation Agency announced the appointment last week of Robert J. Shunk, formerly vice president of Hughes Aircraft Co., as deputy administrator for development in a move that broadens a major responsibility of the agency's headquarters structure.

FAA has not yet who also was appointed to administer the formation of an "Aviation Development Service" under which projects such as the Hughes Tool and the Lockheed C-141 would be consolidated. Nelson George, whose resignation as director of Civil Aviation Board's Bureau of Safety will take effect May 1, has been chosen to head the new FAAS service and will report to Shunk.

Assignment of responsibility continued to offer FAAS services—predominately flight standards, air traffic control research and development and facilities and materials—as well as some 900 staffing positions will follow appointment of Shunk. The majority of present Shunk's staff will inherit, which means design, plan, procurement and major systems, has several responsibilities that FAAS will pursue engineering support research, and contract, as well as Air Force.

Shunk formerly was director of flight research and development division. He will have American System, Inc., as president and assist the FAAS director on May 1. His office, headed by FAAS Administrator N. E. Hulsey but operating in part of a total reorganization of the agency, has never been filled before. FAAS fiscal 1963 budget request lists his salary at \$13,500 per year.



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He 211A-3, designed to operate over 700 mi. range straight, would have a long cylindrical fuselage with wings swept back approximately 30 deg. along the leading edge. Aromatole oxides for the engines are incorporated in the cores of the two sections of the V-tail.

## Heinkel Designs Two DC-3 Replacements

By Carl Breslow

**S**pace West Germany-East France Flugzeugbau is offering two new freight liner proposals, one a 24-passenger turboprop, the other a 27-passenger turboprop, as well as Douglas DC-3-type transports with a 30-passenger capacity. The company is a joint venture of German Deutsche Lufthansa and a local market in France and the U.S.

Aircraft represent industrial extensions of basic proposals defined on 2015 at the request of the West German Ministry of Economics and are designed to automatically cover stage lengths in the 400-700 mi. category and, if either enters into the prototype stage, it would become the nation's first entry in the transatlantic passenger transport field.

The turboprop design, designated the He 211A-1, provides the most novel design aspects of the two, with two General Electric CF 700-2B 18 ft. in diameter of 4,200 lb. shaft each mounted in parallel in the tail section of the fuselage between the two main butterfly tail (SW Apr. 2 p. 78). Clipping guidance

of 22-24 passengers over a minimum stage length of 715 mi. with fuel reserves, the 211A-1 has a cruising speed of 342 mph at an altitude of 20,000 ft. Maximum range without reserves is 2,235 mi. Minimum gross weight is 24,700 lb.

Vertically opposite, the 211A-1, is a conventional low-wing design, featuring 23-25 passengers in a maximum range of 444 mi. with reserves. Without reserves maximum range is 24,000 ft. 1,819 mi. at a cruising speed of 380 mph. Proposed powerplants are two Loening T55 turboprops of 3,700 shp each. Minimum gross weight is 23,510 lb.

Should the B1 version go into development, it could conceivably encompass the widest potential of the Douglas 2015 project (AW Apr. 16, p. 16), now under consideration by the U.S. Air Force primarily within Range 2. With a substantially larger cargo capacity, but also excluding the tail engine installation principle, could be used to service the stage type than

that least structure at those recommended for the 211A-1.

For the moment, however, there is little external evidence that either Heinkel proposal stands to gain government financial support, and the company is probably right in its assessment of a U.S. market of sufficient size to allow it to enter in any market in the aerospace and short-haul airfreight markets.

Heinkel staff in control of the task of import the government has given that it is aiming to re-establish the West German industry as a broad base by encouraging the development and production of commercial aircraft for the domestic and export markets. After noting that the present proposals are without the project originally envisaged in 1958, Heinkel said:

"In 1958, the German Federal Ministry of Economics approached the aerospace industry on the possibility of developing a plane for the carriage of 20-25 passengers in the 1,000-1,500 mi. range. It was left up to the participating firms to decide whether they should plan to build small sports aircraft or medium-large passenger aircraft. It was agreed that the plane would be submitted to the (West German) Deutsche Lufthansa, which would evaluate them on an objective basis. It was further agreed that the Ministry of Economics would make available the capital to develop the projects found suitable by Deutsche Lufthansa."

The Heinkel Co. submitted designs for the development of 20-25 passenger short-haul aircraft with a take-off weight of about 10 tons. These designs had the identification numbers He 211A and He 211B. Deutsche Lufthansa gave its approval to the safer plane He 211A, together with the project of another plane for a large aircraft (a 70 passenger March 9 design prepared by Hanseatic Flugzeugbau).

"Underhandedly, however, hoping that the competition would produce a German civil aircraft more to safety, and

### Heinkel He 211 Specifications

	A-1	B-1
Wingspan	100 ft. 0 in.	100 ft. 0 in.
Length	87 ft. 0 in.	87 ft. 0 in.
Passenger load	24 passengers	27 passengers
Passenger capacity	23-25 passengers	23-25 passengers
Gross weight	44,000 lb.	44,000 lb.
Take-off weight	44,400 lb.	44,300 lb.
Max. gross weight	71,030 lb.	74,250 lb.
Cruise speed at 11,000 ft.	342 mph	312 mph
Max. range at 17,000 ft.	2,235 mi.	2,025 mi.
Initial fuel reserves	4,600 lb.	3,780 lb.
(with full reserves)	525 lb.	415 lb.
Cruise speed at 26,000 ft.	303 mph	292 mph
Max. range at 26,000 ft.	1,819 mi.	1,629 mi.
(without fuel reserves)	444 mi.	315 mi.
(with full reserves)	515 mi.	360 mi.
Time to climb to 26,000 ft.	14.5 min.	17.5 min.
Takeoff distance over 15 ft. obstacle	1,751 ft.	2,025 ft.



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parts funds have not yet been put up to launch the program.

While Leitman originally gave the nod to the outboard, Heinkel was to prove operating difficulties gave the advantage of the CfT 700. In addition, other manufacturers now give the CfT 1100-1130 a slight short field advantage except in narrow where short takeoff and landing capability is a necessity.

The 1958 proposal—the He 211B—was built around three 2,400 lb thrust General Electric J47 turbojet power plants configured along the same gear and fuselage as the engine installations for the Boeing 727 and the Hawker DH128 jet transports—one installed on either side of the rear fuselage, the third housed in the tail with an intake drawing from beneath the aircraft. Configuration range was of between 10 and 21 passengers, the three-jet 210 had a design cruise speed of 700 mph at 26,000 ft.

Maximum range with fuel reserves, however, was only 350 mi.

In selecting its design, Heinkel attempted to fit three jets in a nacelle where competitive aircraft did not already hold over and decided upon aircraft that might have roles potential in four main jet areas:

- Scheduled air services where income depends upon passenger miles flown, in particular feeder services and short-haul traffic as domestic and foreign routes.
- Charter traffic, services to coastal routes, etc.

• Long-haul flights operating as intra-area.

• Service operated by state authorities (breeding, air VIP, research, etc.).

The combination of factors led the engineers to the present design criteria, the aircraft had plus limited passenger loads at out-of-gauge operating costs. To obtain the necessary economy, Heinkel decided upon a line-dog design with a relatively small landing weight for both the takeoff and landing development plus high wing loadings to avoid increased cruise altitude requirements over short ranges. Positioning of the high side exhaust intakes also was taken into consideration.

Major features include lower fuel consumption at holding altitudes with the result of longer range, greater range.

A high-wing design originally was selected later to permit use of large diameter propellers for maximum static takeoff performance. -1300 ft was increased with 17.5 ft to the B-1 and a resultant drop in required fuel requirements again saved over the terminal aspect. The additional power generated in the propulsor that also has permitted a 4 ft stretch of the fuselage to 62.8 ft.

The basic aircraft, with relatively small auxiliary intakes, plus adoption of a butterfly tail as a substitute for the conventional ventral fin on the B model also has resulted in less drag and a consequent gain in speed and range according to Heinkel.

Another feature is protection from possible ground ingestion by protective side panels that automatically retract into the tail surfaces when the aircraft

landing gear folds back into the housing. The fuel load totaling 6,614 lb is stored internally in the wing root in two tanks, each of which is balanced beneath the rear wing sections.

Passenger loadings that can be accommodated depends upon the seat utilization. If they are positioned lengthwise, there is space for 22 seats in a broachet configuration along both sides of the aisle. Another two can be seated for a total of 24 if the seats are placed so that they include 18 deg forward cargo space. The first four rows also can be removed.

Major changes in the A-1 Heinkel from the 1955 predecessor involve the rear fuselage being 10 ft longer.

A high-wing design originally was selected later to permit use of large diameter propellers for maximum static takeoff performance. -1300 ft was increased with 17.5 ft for the A-1. When Leitman gave relatively little weight to the short takeoff aspects in its original evaluation of the competing aircraft, Heinkel shifted to the low-wing configuration, a move that provided weight savings through a lightening of the landing gear structure, a thinning of the engine nacelle housing over and a simplified construction through use of center fuselage ribs.

The new configuration also boasts more range, traveling 13,000 ft altitude from the former 582 mph to 456 mph for the A-1. On both models all fuel is carried internally in the wings.



THREE-VIEWS show general design changes in the Boeing He 211 series of turboprop and turbojet short-haul aircraft proposals drafted between 1955 and late 1958. Major change between the A and A-1 Heinkel models involves shift from a high wing on the 1955 proposal to a low wing design on the later A-1. Heinkel sought savings and clever logic as the A-1 resulted in increased cruise speed and range. The He 211B proposed in 1958 averaged use of three General Electric J45 powerplants, one positioned on each side of the fuselage, the third housed in the tail section. Later B-1 has two GE CF700-3B's, one positioned on each side of the fuselage, the third housed in the tail section.



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- Close-pitched 14-in high cabin windows provide excellent aerial views for all passengers whatever the layout.

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JET SUCCESSOR TO THE VISCOUNT WITH EVEN BETTER THAN VISCOUNT ECONOMICS

**ONE-ELEVEN**

TWO ROLLS-ROYCE SPEY TURBOFAN ENGINES

**BRITISH AIRCRAFT CORPORATION**

ONE HUNDRED PALL MALL, LONDON SW1, ENGLAND  
USA: BRITISH AIRCRAFT CORPORATION (USA) INC.,  
200 JEFFERSON DAVIS HIGHWAY, ALEXANDRIA, VIRGINIA

# NEW! ON WESTERN AIRLINES

## NEW!

Nonstop service between San Francisco and Las Vegas

## NEW!

The only one-plane thru-service from Seattle/Tacoma and Portland to Las Vegas

## NEW!

Fastest nonstops between Los Angeles and Sacramento, via Jet/Prop Electra II's

## NEW!

Fastest daily flights between Los Angeles and Reno, via Jet/Prop Electra II's

## NEW!

Fastest flights between Reno, Sacramento and San Diego, via Jet/Prop Electra II's

## NEW!

Daily nonstops from San Diego to San Francisco

## NEW!

Only nonstop flights between Long Beach and San Francisco

## Boyd Urging New Short-Haul Transport

**C**arl Arranhauser Boyd, Chairman Alvin S. Boyd last week outlined specific action for a short-haul transport aircraft which he urged industry to develop—with government assistance if necessary.

Boyd criticized a 24-passenger aircraft costing less than \$400,000, that could operate on local service routes of 300 mi. with four intermediate stops and one refueling.

Showing the committee model used for a Douglas DC-3 replacement, Boyd said that the aircraft would probably not be government funded at this time, but manufacturers would be willing to undertake the risk with their own resources. Boyd, speaking in Seattle before the Society of Automotive Engineers, and he believed there is a ready market for such 100-150 seat aircraft.

Here are the specifications Boyd outlined for the aircraft which he said is necessary to reduce which needs of U.S. local service airlines:

- Aircraft should accommodate no more than 24 passengers, but should have adequate space for baggage and \$1000 cu. ft. of cargo, preferable in space that cannot be converted to additional passenger seats.
- Fuel economy should be sufficient to permit four intermediate stops on stage lengths of 300 mi. with no more than one refueling.
- No more than 4,000 ft. of runway should be required and, if possible, seek this down to an emphasis on using vertical take-off.
- Power, including essential electronics, should be less than \$100,000 and "hopefully" under \$400,000.
- Selection of powerplant is important as in the speed, but direct operating cost as including depreciation must be under \$100 per plane miles at an average stage length of 300 mi. and 100 passengers. The cost criteria are firm, and must be met at least over the 100 mi. stage length. It is the next between 50 and 150 mi. that is important for the plane.

Boyd attempted to allay fears that manufacturers may have over a lost market resulting from government withdrawal of subsidies. He said that local service carriers today serve 365 cities on 65,000 route miles using 210 Douglas DC-3 aircraft, and added:

Then DC-3 will be replaced. It is imperative, unreasonable and certainly impossible to assume that government support of the overall services of these carriers will be discontinued substantially more than the retirement of subsidies.

Boyd said that aircraft being introduced into local service fleets were not designed to be efficient under operating conditions to which they are being applied. He said the DC-3 was inefficient in a plus-size fleet on local service routes and thus rated.

Is it possible that the example of the DC-3 cannot be repeated?" He added that "it is difficult to accept the idea that after more than 25 years the market can replace this venerable plane to build its legacy. I believe the engineering talent is present in all of several aircraft companies of this country to design a new aircraft."

Boyd called upon the Congress and committee to encourage more clearly in the design and development of new aircraft. He said that given the committee's role, it is the obligation of the committee to urge its ingenuity to design an airplane that will do the job. It is his belief that he had one held a year over the other.

Boyd warned against expansion of local service routes into transline areas and the costs at larger airports to local service routes. He said:

I would regard the local service

### Transport Contenders

At least three manufacturers are pursuing or have started development of aircraft for the general specification that would be the general specification for the aircraft Boyd is advocating. Their entries:

- Fairchild-Swiss Corp., claims it can produce the 24-passenger-powered transport aircraft in series with local service routes as in responsive to the 24-passenger airplane for local service of the isolated local level market. Fairchild is contending that a combination engine-powerplant F-27 is suited to the requirement and simpler than developing a more powerful twin-engine aircraft.

• Convair Aircraft Engineering Corp. is building a 24-passenger aircraft prototype, the Convair 880, which is claimed to have a capacity of 24 passengers. It is the next over the TAI which will be turned over to TAI which will fit it over and around to TAI's needs.

The aircraft will then be flown back over the 3000 mi. to Tokyo and turned over to TAI for the return flight to Southeast Asia, although TAI also hopes to schedule 900 service from Bangkok to Singapore and Djakarta in Southeast Asia.

Net effect of the arrangement will be to bolster the competitive position of TAI of which SAS is a 30% owner, as well as increase the worldwide utilization rate of the aircraft. Because of 900 delivery delays, SAS forced Douglas DC-8 to fit the Far Eastern routes and now plans to re-evaluate the Far Eastern routes. The revised route 900 schedule, it is believed, will be consistent with Douglas' original plan.

Current of that portion of their present certificates which sits in part that the present purpose of this certificate is to influence and require it to offer short-haul, local or feeder air transportation services.

He added that he was confident that Board members intended that such a policy be continued and that carriers will not be relieved of their accepting obligations because they may have acquired or intend to acquire equipment necessary to services found to be in an operating position.

He explained the need for such regulation and then concluded that it "would be consistent with the goal of subsidy reduction to contemplate underwriting equipment used for such services and long range operations, that might be acquired for the purpose of competing with franchises or franchise interests."

## Thai Airways to Begin 990 Service in May

**S**Stockholm—Thai Airways International will begin operating Convair 990 aircraft from Bangkok over to Tokyo on May 31 under terms of a recently signed and sealed agreement with Scandinavian Airlines System (SAS) (AW, Apr. 7 p. 33).

Although officially described as a "joint venture operation," the arrangement really will be based on the basis of an equipment interchange during its initial stages at least. Under present plans, SAS will suffer trans-shipment losses in Tokyo with the two aircraft running 990s at an overall loss from Thailand to Sweden. When an aircraft arrives in Tokyo it will be turned over to TAI which will fit it over and around to TAI's needs.

The aircraft will then be flown back over the 3000 mi. to Tokyo and turned over to TAI for the return flight to Southeast Asia, although TAI also hopes to schedule 900 service from Bangkok to Singapore and Djakarta in Southeast Asia.

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## New Shell designed refueler "inspects" every drop of fuel it delivers—can pump 600 gpm to reduce fueling time

Shell has designed a new refueler that can pump 600 gallons of fuel per minute, "inspects" it for cleanliness and can shut itself off automatically to help assure outstanding quality. It even has a "gold-fish bowl" cab (see picture) for maximum visibility.

Read how its maneuverability, front-end refueling system and built-in elevator help make this vehicle exceptionally safe, efficient and simple to use.

**T**HE picture on the left shows the bareness and size of Shell's new 30,000-gallon refueling truck.

Airmen are happy with the new refueler because it helps them reduce costly ground time for their jets. Here's how: Each refueler can pump 600 gallons of jet fuel in 10 seconds. Working as a team, two airmen can refuel an aircraft—20,000 gallons—in 17 minutes.

The refueler's low efficiency line is maneuverable with ease into refueling position between engine puds.

The new Shell truck's cab even has a nod of glass, allowing the driver in position the truck safely and safely.

### Front refueling for efficiency, safety

Refueling is done from the front of Shell's refueler. There is less chance of accident.

The new truck even has an elevator (the pumping platform is hydraulically operated). This makes it easier to hook up refueling hoses to a plane. Each truck has a special floor-separator. It is

designed to meet user military specifications for fuel cleanliness—and the even stricter specifications imposed by Shell scientists themselves.

Special "precisions" are taken right at maximum all along the line, whenever fuel is transferred from one container to another—from refinery to truck to large to storage tank to truck to aircraft.

### Checks and double checks to prevent accidents

It's highly unlikely that water could get into the new refueler. But if it should, this remarkable unit is designed to prevent it from getting into an airplane's tank. Each refueler has a highly sensitive water-shut device. If it detects water in the fuel, a float-water separator shutoff valve can stop the pump in half a second.

The "deadman's control" is another safety device. It allows operation by remote control, and gives the operator freedom to choose the most fueling operation from the best location.

**Shell** is the nation's leading supplier of commercial aviation fuel—and has been for more than a decade.

Should trouble occur, the "deadman's control" can also stop the pump.

### More automatic features

Pump-up pressure is regulated automatically. The truck's brakes lock automatically when the pumping operation begins. They cannot release until pumping is finished and the hose is returned to its receptacle in the truck.

There are just a handful of the many features Shell has designed into this remarkable truck. They give you an idea of how much ingenuity and care Shell and its dealers devote to serve aviation better.

For full information on Shell's aviation products and services—including refueling deckplants—write: Shell Oil Company, 36 West 50th Street, New York 20, New York.





How you can operate more reliably... more economically... with these first proofs of the Solid State generation in airborne electronics. Collins' use of microelectronics now brings you the 1024-1 Master Receiver and 311VA Glidetube Receiver — first of a line of Solid State Systems that mean big savings to you. ■ They are smaller than any other. They are lighter than any other. They require less power than any other. They are more rugged than any other. ■ They work — as will all Collins Solid State Systems — the circuit excellence that makes Collins first choice in airborne electronics. ■ Contact us today for complete information. Collins Radio Company • Collins Radio • Dallas • Los Angeles • New York



## SHORTLINES

■ **Air Transport Asia** reports U.S. tonnage flew 1,616 billion metric passenger miles during March, compared to 1,602 last quarter total to 7,800 billion. The figure represents increases of 13.6% and 36.3% over the same period last year, but last year's figures were low due to strikes.

■ **Alitalia Airlines** reports a 5.5% increase in passenger traffic in both directions across the North Atlantic during the first quarter of 1982, a period when seating capacity rose 44%. The airline carried a total of 15,357 passengers between U.S. and Canadian gateways and London, Milan, and Rome during the first quarter.

■ **American Airline** reports it flew 692,800 passengers 384 million revenue miles in March — a gain of 4% and 7% respectively over last March.

■ **British West Indian Airways** has added CAR in an approve instead 17 day extension from New York and Antigua, Barbados, Trinidad and Tobago. BWIA also seeks approval to reduce existing 30 day extension from both New York and Miami to Caribbean points. Greatest reductions—about 20%—would be New Yorkish solo, cutting the new for to 10/99 from 3/24. Plan would become effective May 18 if CAR approves.

■ **CAE** leasing in the Americas-East Asia venture which replicates a set for 10 a.m. May 10 at Bus 725 at Board headquarters in Washington.

■ **Central Airlines** has asked CAR to approve special low-cost round trip fares between the port of one competitor on its routes. The rates, to be called "Bigots' Fares," will enable round-trip passengers to return leg at 25% of the regular one-way fare within four days of departure.

■ **Eastern Air Lines** will increase its New York to San Juan Puerto Rico nonstop DC-8 flights from two to four flights daily, April 29 and from five to six flights daily, July 1. The DC-8s, in 334 seat configuration, will replace DC-6B aircraft.

■ **TWA** World Airlines reports first quarter revenues of \$83.1 million—higher so far as last year, according to TWA. Pre-tax losses for the period were \$10.3 million, compared with \$18.6 million for the same time last year. However, after tax losses totalled \$17.4 million for the period, compared with \$3.3 million last year.

## AIRLINE OBSERVER

■ Watch for Federal Aviation Agency to insist that the controversial automatic procedure governing takeoffs from Milwaukee Airport's Runway 16R be made less complicated. Milwaukee FAA Administrator N. E. Hulme has appointed George Prill, director of the agency's Flight Standards Service, an on-call head of the FAA team trying to resolve the issue of the Mar. 1 crash of an American Airlines 707-373B at Milwaukee. FAA managers under Prill insisted more possible emergencies than the American jet could have encountered after departing Runway 16R, but failed to find any significant short. But Prill and Hulme hope to devise a simpler way to leave the Milwaukee area than the present FTE procedure. (AW Apr. 16, p. 30)

■ **Canadian** will build 10 CL-640 helicopter crews transports in addition to those already built under firm orders. Production rate will be one per month at a cost of \$1.5 million each. Five of the 10 are expected to be purchased by the Canadian government for the RCAF and the balance will be built as backlog积压. Look of sales is expected to result in ten more personal contracts which may reach as high as 40% of Canadian's work load by the end of the year. Expected government order for 100 CL-41 jet fighters has yet been received and almost half of the order for 200 CL-640 has been completed.

■ **Lost** for legislation to increase amounts that may be borrowed from the British Treasury by British Overseas Airways Corp. and British European Airways, the two state-owned carriers. The increase is needed to finance replacement equipment for Hawker Siddeley Trident for BEA and Vickers VC10s for BEACo—and to meet loans authorized by both carriers for the current fiscal year.

■ **Cessna** Aviation Research and Development Service is losing status with industry for failing to stage prompt tests of air traffic control system hardware test to the agency's Atlantic Ops, N. J., experimental center for evaluation. According to some senior manufacturers who contract with NASA, the service is often vague on the status of particular projects and sometimes employs a technique of "selection by inference" to put an end to others.

■ **San Francisco & Oakland Helicopter Airlines** has accepted delivery of a single Sikorsky S-62 helicopter to accommodate growing traffic volume in the San Francisco Bay area. (AW Oct. 30, p. 39). Current in-use, handling about 7,000 passengers per month and expects to show its first profit in May.

■ **Lufthansa** has submitted a memorandum to the Card Associates Board investigating foreign air carrier permits which states that, under German law, the Federal Republic cannot make a unilateral change on the interpretation of its bilateral agreement with U.S. The new states that Germany has always interpreted the bilateral as prohibiting each government from regulating capacity, but adds that Germany provides this instance where interpretation could be changed. "Should the U.S. ever protest to find authentication in the agreement on unilateral capacity control, the Federal Republic will be free to make the same discovery."

■ **New round of staff-cutting subsidies** that Aeroflot must be having difficulty finding passengers to fill its rapidly growing number of available seats. The Russian carrier in last April reduced tonnage around 10% on 142 routes, including Leningrad-Odessa, Tashkent-Kingsberg, Kiev-Lvov, Moscow-Odessa, Almaty-Naschchinsk, and Novosibirsk-Irkutsk. On a number of additional routes Aeroflot extended winter season and offer promotional fares until next October.

■ **New members of the Air Line Pilots Assn. board of directors** are expected to arrive in Miami May 29 with no instructions from their local unions on how to vote on the association's proposal. TWA's new members there endorsed the qualification of Capt. John C. Carroll, ALPA first vice president, and National's council endorsed Capt. Charles H. Rubin, now the airline's chief pilot. But these endorsements are not binding on the approximately 380 local unions who will elect the union's president.

### **Turbine Aircraft 1961—Cents per Revenue Mile**



**SOLO FIRING:** Sequence photos show America's first solid-fuel intercontinental ballistic missile, Minuteman, having just left underground silo at Cape Canaveral, Florida. Test U-8 Air Force missile, described as an "unassisted breakthrough" in terms of procurement and procurement costs, is simple, compact, quick

bring. Maintenance minutes will be stored underground at one bunker against nuclear attack. Boeing is weapon system integrator, responsible for Munitions assembly, test, launch control and ground support. The Montezuma KSRM weapon systems will be operational late this year, a year ahead of original schedule.

## *Capability has many faces at Boeing*



**DISTANCE CHAMP.** A Boeing B-52H missile booster set new world distance record, flying 12,248 miles from California to Spain, non-stop, without refueling. This Strategic Air Command flight demonstrated the global reach of the missile launching Boeing B-52s.



**WATER, WATER.** Now U. S. Army has but one two-boeing jet turbine engine to drive two pumps, and handling 2000 gallons of water a minute. Turbines weigh 225 pounds each, 600 ft. 200 ft. Though tested Boeing believes she powers U. S. Navy submarine, submarine, gunboats, and personnel boats.



**GLENN RICHARD**, in super-veteran status, starring in his 100th straight magazine cover and *People Magazine's* 1000th. *Entertainment Weekly* interviewed him about his career, his new book, and his thoughts on the state of the industry.

	String Operations	String Manufacturing	Sub-Total	Depot/Opn & Service	Total String Supplies	Revenue Actual Million
<b>SCOTT 737</b>						
America	87.20	54.91	122.31	36.05	161.31	38,400.9
Brazil	124.76	63.38	147.93	43.34	190.99	4,164.4
Central	64.84	59.39	124.23	24.22	148.45	12,219.3
Europe	104.80	54.91	159.71	27.00	186.71	20,200.0
East World	93.31	36.23	131.64	63.04	176.69	45,997.4
Medium	84.28	55.65	139.93	82.83	221.33	2,346.8
	107.28	56.98	163.36	34.09	198.35	
<b>SCOTT 738</b>						
<b>SCOTT 738</b>						
America	120.20	65.00	144.20	33.34	178.64	2,019.9
Europe	120.98	55.94	146.92	50.18	192.64	15,370.2
Medium	79.49	55.41	134.90	25.04	160.13	2,377.6
North America	113.41	34.93	147.87	42.63	190.50	7,446.3
North America	113.41	34.93	147.87	42.63	190.50	7,446.3
East World	113.38	35.23	147.21	24.88	204.49	28,084.6
East World	113.38	35.23	147.21	24.88	204.49	28,084.6
East World	99.70	39.99	139.67	57.87	190.94	6.67
	101.29	34.91	136.49	55.46	188.98	
<b>SCOTT 739</b>						
America	81.77	34.32	113.27	38.81	151.43	26,162.9
Brazil	94.03	33.41	126.45	54.94	161.59	2,329.3
Central	75.13	11.93	84.98	49.27	134.25	2,130.8
Europe	102.00	32.00	134.00	49.27	183.27	20,200.0
East World	95.33	44.46	139.49	115.63	236.06	1,380.3
Medium	79.33	31.48	120.03	43.24	152.27	20,188.3
Medium	97.34	43.26	143.03	38.89	179.91	2,087.8
	96.84	30.91	116.89	42.86	158.75	
<b>SCOTT 740</b>						
America	120.24	41.99	144.43	43.27	187.73	204.9
Brazil	94.04	26.95	120.37	38.87	176.64	9,389.9
Central	88.51	33.49	121.93	41.79	170.64	2,087.7
Europe	112.70	31.95	151.26	42.29	193.18	16,997.2
East World	80.84	32.47	120.00	51.84	182.24	
	100.40	32.47	120.00	51.84	182.24	
<b>SCOTT 741</b>						
<b>SCOTT 741</b>						
America	96.26	33.06	129.34	37.10	168.46	1,702.3
Brazil	111.10	81.98	200.64	46.15	266.31	264.9
Central	88.73	36.49	127.34	44.79	174.14	
	96.84	30.91	116.89	42.86	158.75	
<b>SCOTT 742</b>						
<b>SCOTT 742</b>						
America	96.26	33.06	129.34	37.10	168.46	1,702.3
Brazil	111.10	81.98	200.64	46.15	266.31	264.9
Central	88.73	36.49	127.34	44.79	174.14	
	96.84	30.91	116.89	42.86	158.75	
<b>SCOTT 743</b>						
<b>SCOTT 743</b>						
America	70.20	58.47	129.58	85.00	195.55	14,281.1
Brazil	61.63	36.51	109.64	31.86	159.40	4,341.1
Central	73.77	17.70	111.91	49.77	160.85	11,411.8
East World	61.63	27.70	105.79	30.79	152.52	2,711.1
Medium	60.05	42.16	100.63	38.18	139.26	7,103.1
	70.20	58.47	129.58	85.00	195.55	
<b>SCOTT 744</b>						
<b>SCOTT 744</b>						
America	70.20	58.47	129.58	85.00	195.55	14,281.1
Brazil	61.63	36.51	109.64	31.86	159.40	4,341.1
Central	73.77	17.70	111.91	49.77	160.85	11,411.8
Europe	73.77	26.93	106.70	48.77	162.87	8,702.9
East World	61.63	27.70	105.79	30.79	152.52	2,711.1
Medium	60.05	42.16	100.63	38.18	139.26	7,103.1
	70.20	58.47	129.58	85.00	195.55	
<b>SCOTT 745</b>						
<b>SCOTT 745</b>						
America	70.20	58.47	129.58	85.00	195.55	14,281.1
Brazil	61.63	36.51	109.64	31.86	159.40	4,341.1
Central	73.77	17.70	111.91	49.77	160.85	11,411.8
Europe	73.77	26.93	106.70	48.77	162.87	8,702.9
East World	61.63	27.70	105.79	30.79	152.52	2,711.1
Medium	60.05	42.16	100.63	38.18	139.26	7,103.1
	70.20	58.47	129.58	85.00	195.55	
<b>SCOTT 746</b>						
<b>SCOTT 746</b>						
America	70.20	58.47	129.58	85.00	195.55	14,281.1
Brazil	61.63	36.51	109.64	31.86	159.40	4,341.1
Central	73.77	17.70	111.91	49.77	160.85	11,411.8
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Medium	60.05	42.16	100.63	38.18	139.26	7,103.1
	70.20	58.47	129.58	85.00	195.55	
<b>SCOTT 747</b>						
<b>SCOTT 747</b>						
America	70.20	58.47	129.58	85.00	195.55	14,281.1
Brazil	61.63	36.51	109.64	31.86	159.40	4,341.1
Central	73.77	17.70	111.91	49.77	160.85	11,411.8
Europe	73.77	26.93	106.70	48.77	162.87	8,702.9
East World	61.63	27.70	105.79	30.79	152.52	2,711.1
Medium	60.05	42.16	100.63	38.18	139.26	7,103.1
	70.20	58.47	129.58	85.00	195.55	
<b>SCOTT 748</b>						
<b>SCOTT 748</b>						
America	70.20	58.47	129.58	85.00	195.55	14,281.1
Brazil	61.63	36.51	109.64	31.86	159.40	4,341.1
Central	73.77	17.70	111.91	49.77	160.85	11,411.8
Europe	73.77	26.93	106.70	48.77	162.87	8,702.9
East World	61.63	27.70	105.79	30.79	152.52	2,711.1
Medium	60.05	42.16	100.63	38.18	139.26	7,103.1
	70.20	58.47	129.58	85.00	195.55	
<b>SCOTT 749</b>						
<b>SCOTT 749</b>						
America	70.20	58.47	129.58	85.00	195.55	14,281.1
Brazil	61.63	36.51	109.64	31.86	159.40	4,341.1
Central	73.77	17.70	111.91	49.77	160.85	11,411.8
Europe	73.77	26.93	106.70	48.77	162.87	8,702.9
East World	61.63	27.70	105.79	30.79	152.52	2,711.1
Medium	60.05	42.16	100.63	38.18	139.26	7,103.1
	70.20	58.47	129.58	85.00	195.55	
<b>SCOTT 750</b>						
<b>SCOTT 750</b>						
America	70.20	58.47	129.58	85.00	195.55	14,281.1
Brazil	61.63	36.51	109.64	31.86	159.40	4,341.1
Central	73.77	17.70	111.91	49.77	160.85	11,411.8
Europe	73.77	26.93	106.70	48.77	162.87	8,702.9
East World	61.63	27.70	105.79	30.79	152.52	2,711.1
Medium	60.05	42.16	100.63	38.18	139.26	7,103.1
	70.20	58.47	129.58	85.00	195.55	
<b>SCOTT 751</b>						
<b>SCOTT 751</b>						
America	70.20	58.47	129.58	85.00	195.55	14,281.1
Brazil	61.63	36.51	109.64	31.86	159.40	4,341.1
Central	73.77	17.70	111.91	49.77	160.85	11,411.8
Europe	73.77	26.93	106.70	48.77	162.87	8,702.9
East World	61.63	27.70	105.79	30.79	152.52	2,711.1
Medium	60.05	42.16	100.63	38.18	139.26	7,103.1
	70.20	58.47	129.58	85.00	195.55	
<b>SCOTT 752</b>						
<b>SCOTT 752</b>						
America	70.20	58.47	129.58	85.00	195.55	14,281.1
Brazil	61.63	36.51	109.64	31.86	159.40	4,341.1
Central	73.77	17.70	111.91	49.77	160.85	11,411.8
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Medium	60.05	42.16	100.63	38.18	139.26	7,103.1
	70.20	58.47	129.58	85.00	195.55	
<b>SCOTT 753</b>						
<b>SCOTT 753</b>						
America	70.20	58.47	129.58	85.00	195.55	14,281.1
Brazil	61.63	36.51	109.64	31.86	159.40	4,341.1
Central	73.77	17.70	111.91	49.77	160.85	11,411.8
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East World	61.63	27.70	105.79	30.79	152.52	2,711.1
Medium	60.05	42.16	100.63	38.18	139.26	7,103.1
	70.20	58.47	129.58	85.00	195.55	
<b>SCOTT 754</b>						
<b>SCOTT 754</b>						
America	70.20	58.47	129.58	85.00	195.55	14,281.1
Brazil	61.63	36.51	109.64	31.86	159.40	4,341.1
Central	73.77	17.70	111.91	49.77	160.85	11,411.8
Europe	73.77	26.93	106.70	48.77	162.87	8,702.9
East World	61.63	27.70	105.79	30.79	152.52	2,711.1
Medium	60.05	42.16	100.63	38.18	139.26	7,103.1
	70.20	58.47	129.58	85.00	195.55	
<b>SCOTT 755</b>						
<b>SCOTT 755</b>						
America	70.20	58.47	129.58	85.00	195.55	14,281.1
Brazil	61.63	36.51	109.64	31.86	159.40	4,341.1
Central	73.77	17.70	111.91	49.77	160.85	11,411.8
Europe	73.77	26.93	106.70	48.77	162.87	8,702.9
East World	61.63	27.70	105.79	30.79	152.52	2,711.1
Medium	60.05	42.16	100.63	38		

**BOEING**

# Turbine Powered Aircraft 1961 Operating Expense

FLEET OPERATIONS						
	Cost Expense	Fuel & Taxes	Reserves	Other	Total	
<b>BOEING 707</b>						
Aeronca	126.48	329.40	46.95	3.33	451.80	
Brilliant	116.16	311.21	44.25	6.50	453.91	
Continental	121.79	339.33	44.25	6.50	504.57	
For American	173.48	315.87	31.00	1.00	500.55	
Twa World	166.68	335.79	37.75	6.75	500.20	
Wesair	102.56	310.00	21.00	—	433.56	
P-17 Average	134.56	312.31	47.75	1.50	454.80	
<b>BOEING 720</b>						
Delta	118.12	340.51	41.25	—	460.35	
Eastern	120.77	337.21	47.00	—	464.77	
Northwest	126.93	327.87	47.00	4.42	461.82	
Northwest	124.29	319.75	46.50	—	460.74	
Pan American	140.21	336.35	120.10	14.00	490.35	
Twa World	171.50	326.76	37.50	8.75	423.75	
Wesair	131.18	339.34	31.25	—	422.35	
P-17 Average	141.47	332.11	48.75	8.25	461.50	
<b>BOEING 737</b>						
Aeronca	128.05	317.30	46.75	3.50	451.00	
Brilliant	109.72	334.72	84.25	6.50	421.45	
Eastern	123.79	319.75	31.00	6.50	450.00	
Northwest	120.92	316.31	89.75	1.00	450.85	
Pan American	146.55	312.00	81.00	6.75	421.30	
Twa World	159.92	340.81	83.75	8.75	480.40	
United/Castle	132.05	317.25	94.25	—	426.50	
Wesair	—	—	—	—	—	
P-17 Average (Excl. Eastern)	138.15	329.91	48.75	3.00	450.15	
<b>CONVAIR 880</b>						
Aeronca	86.25	342.61	314.10	—	461.50	
Brilliant	123.25	319.24	84.10	—	420.35	
Eastern	120.25	317.25	47.00	6.50	450.00	
Northwest	120.58	316.91	95.00	8.75	450.45	
Twa World	132.05	340.81	83.75	8.75	480.40	
P-17 Average	124.45	317.91	82.31	6.50	451.45	
<b>SUD CARAVELLE</b>						
None	81.47	377.44	22.25	1.75	377.45	
<b>CANADIAN 614</b>						
Flying Tiger Brussels/	81.15	35.22	48.00	—	350.40	
P-17 Average	104.45	349.80	47.50	6.00	350.50	
<b>TRINITY 880/800</b>						
None	28.25	359.31	31.00	6.75	397.00	
<b>LOCKHEED ELECTRA</b>						
Aeronca	127.25	379.95	11.25	3.25	479.45	
Brilliant	79.64	331.72	80.25	14.00	479.17	
Eastern	117.79	329.25	32.25	30.25	450.25	
Northwest	124.40	317.50	17.50	12.50	430.50	
Pan American	102.36	94.45	35.50	1.15	221.50	
Twa World	132.42	79.05	32.00	6.00	181.50	
P-17 Average	103.46	316.94	19.25	6.75	450.50	
<b>WICHITA WIZARD</b>						
None	8.25	58.33	4.75	0.00	129.75	
None	23.43	26.62	30.00	0.00	118.00	
None (Capt.)	74.46	54.09	5.50	8.15	151.90	
P-17 Average	49.10	56.94	4.75	0.00	138.35	
<b>BLAND CONVAIR</b>						
None	55.11	377.70	17.75	1.15	450.00	
<b>FAIRCHILD 737</b>						
Aeronca	122.55	324.14	11.50	6.00	447.05	
Brilliant	87.46	343.33	10.75	0.15	433.55	
None	20.33	46.07	18.00	0.00	120.00	
None	49.00	34.45	11.75	8.00	140.25	
None	49.44	22.27	11.75	8.00	140.25	
None	49.44	22.02	15.25	8.00	140.25	
None	49.15	36.34	16.00	8.00	140.40	
None	49.25	42.27	37.75	1.25	140.45	
P-17 Average	49.17	319.44	18.00	1.00	450.45	
1-Year Ending Sept. 30, 1961						

# -Dollars per Total Aircraft Hour

	DIRECT MAINTENANCE				Flight Operations 4 Flight Maintenance	Repairs/Refu- els & Wear	Total Direct Expense	Total Aircraft Hours
	Air Freight	Other Flight Expenses	Total	Ground Maintenance				
<b>BOEING 707</b>								
Aeronca	76.46	29.31	10.45	162.80	350.57	134.76	709.89	45,426
Brilliant	76.21	29.11	10.45	161.93	347.17	134.76	708.75	45,426
Continental	68.83	85.24	10.75	142.03	329.39	113.09	671.28	21,583
Pan American	70.20	32.00	18.00	179.00	489.15	204.60	645.84	—
Twa World	61.43	74.82	16.00	166.70	470.82	220.87	674.72	87,472
Wesair	27.87	112.07	4.25	137.31	276.47	266.38	421.72	1,004
P-17 Average	76.21	31.31	10.45	161.80	347.37	131.20	709.89	45,426
<b>BOEING 720</b>								
Aeronca	47.79	104.00	2.00	151.00	304.33	259.30	893.50	15,844
Brilliant	46.51	42.73	14.00	147.00	426.97	218.79	847.00	25,425
Continental	47.21	104.00	2.00	151.00	304.33	259.30	893.50	15,844
Northwest	47.21	99.04	13.50	144.74	305.34	239.15	895.00	15,844
Pan American	50.00	72.00	14.00	137.00	471.72	223.87	1,203.28	4,207
Twa World	47.44	42.00	24.00	147.00	481.41	210.47	894.40	15,844
P-17 Average	47.21	42.00	13.50	144.34	304.91	219.38	709.22	11,100
<b>BOEING 747</b>								
Aeronca	119.90	147.00	14.00	300.90	512.00	381.00	944.90	—
Brilliant	119.61	146.73	14.00	300.73	511.43	380.50	944.43	—
Continental	119.32	146.46	14.00	300.46	510.87	379.25	943.87	—
Northwest	119.03	146.19	14.00	300.19	510.30	378.00	943.30	—
Pan American	120.85	145.92	14.00	300.92	511.75	376.50	944.75	—
Twa World	120.56	145.65	14.00	300.65	512.18	375.25	944.18	—
P-17 Average (Excl. Reserves)	119.71	146.33	14.00	300.33	511.00	374.50	943.00	—
<b>CONVAIR 880</b>								
Aeronca	47.54	71.03	4.00	121.00	312.00	181.00	701.00	44,720
Brilliant	47.45	71.03	4.00	121.00	312.00	181.00	701.00	44,720
Continental	47.81	71.34	3.75	121.75	312.25	181.25	701.25	44,731
Northwest	47.25	71.03	4.00	121.00	312.00	181.00	701.00	44,720
Pan American	50.25	71.84	9.75	123.25	317.25	182.50	704.50	44,724
Twa World	47.54	71.03	4.00	121.00	312.00	181.00	701.00	44,720
P-17 Average	47.89	71.76	12.00	121.76	312.89	181.89	701.89	44,727
<b>CONVAIR 990</b>								
Aeronca	50.45	112.00	5.75	161.75	344.50	214.75	702.50	5,311
Brilliant	50.45	112.00	4.25	161.25	344.25	214.25	702.25	5,311
Continental	50.80	101.07	11.00	212.07	345.00	214.00	703.00	5,324
Northwest	50.00	110.00	12.00	210.00	346.00	214.00	703.00	5,315
Pan American	52.00	101.07	11.00	212.07	347.00	214.00	703.00	5,315
Twa World	50.75	112.00	5.75	161.75	344.75	214.75	702.75	5,312
P-17 Average	50.45	111.36	10.00	160.36	344.00	214.00	702.00	5,310
<b>LOCKHEED ELECTRA</b>								
Aeronca	49.12	129.64	7.50	186.24	381.49	295.92	719.74	78,065
Brilliant	49.26	129.80	12.25	186.05	381.50	295.75	719.75	78,065
Continental	49.26	129.80	12.25	186.05	381.50	295.75	719.75	78,065
Northwest	50.85	65.00	18.00	106.00	201.55	146.00	449.00	20,519
Pan American	50.97	54.84	14.25	91.75	212.47	104.25	449.25	20,519
Twa World	50.94	70.00	17.00	122.00	208.64	120.25	449.42	20,519
P-17 Average	50.94	65.25	12.25	96.25	201.74	147.25	449.25	20,519
<b>WILKES WIZARD</b>								
None	25.44	21.80	7.00	40.20	173.20	41.00	227.70	20,309
None	30.49	24.94	10.16	47.48	186.34	24.00	220.84	20,309
None (Capt.)	30.52	15.70	8.00	40.50	172.70	9.75	171.45	19,444
P-17 Average	30.45	20.00	7.20	40.20	174.00	42.40	220.40	20,308
<b>BLAND CONVAIR</b>								
None	9.77	10.25	2.20	74.25	301.80	48.75	334.80	—
<b>FAIRCHILD 737</b>								
Aeronca	45.55	58.33	4.75	8.00	129.75	—	—	11,100
Brilliant	45.44	58.42	4.75	8.00	129.55	—	—	11,100
Continental	45.55	58.33	4.75	8.00	129.75	—	—	11,100
None	20.33	46.07	8.00	—	120.40	—	—	—
None	49.44	54.09	5.50	8.15	131.90	—	—	—
None (Capt.)	49.44	22.02	12.25	15.00	124.25	—	—	—
P-17 Average	45.55	56.34	10.00	8.00	129.55	—	—	11,100
None	45.55	58.33	4.75	8.00	129.75	—	—	11,100
None	45.44	58.42	4.75	8.00	129.55	—	—	11,100
None	45.55	58.33	4.75	8.00	129.75	—	—	11,100
None	45.44	58.42	4.75	8.00	129.55	—	—	11,100
None	45.55	58.33	4.75	8.00	129.75	—	—	11,100
None	45.44	58.42	4.75	8.00	129.55	—	—	11,100
None	45.55	58.33	4.75	8.00	129.75	—	—	11,100
None	45.44	58.42	4.75	8.00	129.55	—	—	11,100
None	45.55	58.33	4.75	8.00</td				



BRISTOL T.188 test-bed should operate as an auxiliary parasite fitted to side of fuselage. Main engine is rotated in case under the wing is not operated by power control within fuselage. Rudder is balanced and is power-operated. The strakes and struts's

## T.188 Will Be Testbed for British Mach

By Herbert J. Colcock

London-Britain's newest flight research tool, the Mach 2 research and Bristol T.188, will take a leading role in investigating a new generation of supersonic jet engines and high heat engines leading to an Anglo-French Mach 2.2 civil transport.

All-new aircraft has been specifically designed to take a variety of powerplants and sophisticated skin configurations for both civil and military test in the supersonic parameters. The T.188 began its flight test program this month (AW Apr. 28, p. 29).

The T.188, more briefly, represents a host of aircraft ever built in Great Britain, also the first to have a sophisticated power control and data processing unit developed at Royal Aircraft Establishment at Filton, where T.188 test flights will be made.

As the only European airplane designed specifically to explore high heat regeneration and taking off from a base power, the T.188 has a history of complex design problems because of its unique test configuration (AW Mar. 17, 1961, p. 93).

The airplane which has just flown is one of three built under Ministry of Aviation contract. Second T.188 is in advanced stages of construction at Filton and the third is at Royal Aircraft Establishment, Farnborough, for static testing under conditions of extreme heat, well over 300°C.

The T.188 is only part of an overall seventh effort by British designers to cover various stages of supersonic flight. The Hawker-Siddeley BPF 114 will be the "thin" delta-wing stud at the low-speed end of the spectrum (AW cover, Sept. 10, 1961).

Next airplane will be a modified

Folland FD.2 delta which set the world's record nose-up of 1,117 mph in 1960. Another is being fitted with an experimental wing at Bristol, which is a similar to that planned for the Mach 2.2 Super Cassiopeia transport.

Under the Ministry of Aviation specification, the Bristol T.188 followed these design requirements:

- Capability of sustaining supersonic speeds well in excess of 1,500 mph for periods long enough to establish steady conditions for study of structural heating, cooling effects and aerodynamic phenomena at Mach 1.

- Takeoff under its own power (two R.1075F Gnome engines) from 100 ft to operating height in a research pattern which allows no stalls.

- Preparation for the use of the T.188 in programmatic research on propulsive development.

- Means for collection of data in greater

detail and detail than previously.

One of the main problems was surface recontamination, reducing temperature-cooling capacities. Mach 1 has been recontaminated and specially designed for the T.188 and all seats had to be packed against the high kinetic heating flux and assistance.

Dr. W. J. Stimp, Bristol's chief engineer, said that the T.188 will be under continuous control from the ground, through constant VHF radio control. The airplane has no navigation aids other than radio, since even a compass magnetic compass would be affected in the reference plane, the pilot will be directed to another point in Great Britain following older procedures on a map transmitter.

Aircraft itself will carry several heat-shield freonlines. Two independent telemetry systems of Royal Aircraft Establishment design, manufactured by

## AERONAUTICAL ENGINEERING



TWO SEAT HAYWARD GYRON JR. DCT. 10 powerplants are needed for test mass at the T.188 engine test site at Filton. Bolts on top of nozzle contain one-shot fire extinguisher



CLOSEUP of unit of the T.188 landing gear and wheel by left. Unit was designed by Goodwin. Section of T.188 landing gear right is example of shallow construction. Note close-pitched corrugated ribs. Struts used are monolithic, in both strength and stiffness



EARLY CONFIGURATION of the Bristol T.188 wing planform and nose gear flight tested on solid-fueled rocket at British Army Wing-on-Pavement Range at Alesforth. Model was instrumented and data was transmitted to ground monitoring station







## Kellogg has won its wings, too



You might say Kellogg originally won its wings in 1919 — when the first aircraft to cross the Atlantic was equipped with a Kellogg fuel pump. This was before there was such a thing as an airline — much less jet flights spanning oceans and continents. In a matter of hours. Reliability is even more important today. That's why so many jet airliners use Kellogg pumps, fuel motors, or hydraulic systems.



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include variable geometry, afterburning, convergent-divergent multi-spool nozzle and low frontal area. Thrust, with afterburning, is about 16,000 lb.

The nozzle is mounted on a wing which has a chord of 35 ft. It is located in an area of 306 sq. ft. Wing is at an angle between the fuselage and centerline, but outboard of the nozzles; the sharp leading edge is swept back at an angle of 35 deg. Tip of the wing, framed by the balance arms of the aileron forward of its hinge, has a leading edge sweep back of 66 deg.

Leading and trailing leading edge slats, Dr. Strong explained, in give a maximum deflection of 10 deg at Mach 1.4 although he added that the winging will not be expected to give any significant benefit at the Mach 1 top speed.

In addition, the T-118 has an extremely low drag coefficient at transonic speeds, the transonic peak of the pressure field over the entire aircraft. Since the surfaces have been contoured 500 centimeters in the subsonic domain, any induced effort was expended as flow control instead. Dr. Strong and final solution was a shock wave occurring downstream in a region, the configuration being between the sonic surface pressure and the pressure in a region just in front of the shock wave. He said tests show the aircraft is capable of maintaining normal flow conditions during sonic changes of engine rpm flow.

Special laboratory rigs have been designed for development and checkout of the T-118's wing system, including a full scale model of a center longitudinal section of tank, airframe and connecting piping. Components are machined by aluminum as air pressure and pressure hoses have been made for precise sealing. The rig can simulate flight attitudes in pitch up to 100 deg, an complete inverted or the strait. Dr. Strong explained that attitude in roll will have no significant effect on the aircraft performance since the fuel system is contained within the fuselage and is dispersed around the center line of the aircraft.

Hydrodynamic systems have been proven on test in which the model is suspended by hydrodynamic supports on fast speed tracks and presented flying control attitudes. Dynamic conduct was built for complete integration of the hydrodynamic system and controls have been linked with a flight simulator to demonstrate pilot with control feel.

Electrical systems are a partly rate gated with the hydrodynamic.

Temperature control unit using the fuel as a heat sink.

As Dr. Strong pointed out, the T-118

can be compared with the North American X-15, aside from the fact that the X-15 is a rocket-powered and was launched from a mothership.

AIRAVATION WEEK AND SPACE TECHNOLOGY, April 30, 1972

## PRODUCTION BRIEFING

British Ministry of Aviation has ordered 40 Folland Gnat advanced jet trainers to replace the Vampire T.11 now used by Royal Air Force. Total order for the Gnat, which uses a Bristol Siddeley Orpheus 101 powerplant, is 105 planes.

Boeing Co. has received a \$5.6 million Navy BuWeps contract for advanced production of A-7D FSG-51 fire control radars for Triton missiles.

Staba Watch Co.'s Research and Development laboratories Division has received an approximately \$1 million contract from the Boeing Co. to design a safety control switch for the Minuteman ICBM. The switch would serve as the final safety "hold" or engine ignition device on all three Minuteman stages prior to launch.

Lent, Inc., Grand Rapids, Mich., has received a \$3,335,112 USAF contract for production of guidance assemblies for F-105D and F-105A aircraft.

Obn Elevator Co., Brooklyn, N. Y., will produce electronic equipment, spares and related material for Boeing B-52 jet bombers under a \$2,239,979 USAF contract.

General Dynamics/Pennsalt has received a \$1.77 million Navy BuWeps contract for further developing work on the Terrier and Tarter missiles.

Thiokol Chemical Corp.'s Research Matrix Division has received an \$8 million Navy BuWeps follow on contract to produce packaged liquid propellant engines for Bullock anti-submarine missiles.

Goodrich Tire & Rubber Co. has developed and tested a multi-spool jet aircraft tire which incorporates a variable pitch tread which provides a balanced wear pattern and improved tire life. The tire is designed for fast speed breakers and improved flying control attitudes. Dynamic conduct was built for complete integration of the hydrodynamic system and controls have been linked with a flight simulator to demonstrate pilot with control feel.

Electrical systems are a partly rate gated with the hydrodynamic.

Temperature control unit using the fuel as a heat sink.

As Dr. Strong pointed out, the T-118 can be compared with the North American X-15, aside from the fact that the X-15 is a rocket-powered and was launched from a mothership.

Center of Naval Analysis will be developed and operated by the Franklin Institute in Philadelphia, under a \$2,247,000 Navy contract. The center will conduct operational analysis studies and research which has been provided to the Massachusetts Institute of Technology and the Institute for Defense Analysis both of which have cooperated in forming the center.

## THERE'S MORE TO AFC'S MINUTEMAN ASSIGNMENT THAN AIR CONDITIONING



Unintended, butified, in their underground silos, the Minuteman must accomplish operational at all times — ready for instant performance. Uniting the Air Force Ballistic Missile Program and their division, American Air Filter developed and is supplying an integral environmental control system including temperature and humidity controls, heating, cooling, refrigeration, and air filtration. Backed with the weapons experience of the aircraft industry, as well as the Minuteman, Centaur missile personnel are positioned by chemical, bacteriological, and radiological and air filters.

American Air Filter capability is based on years of leadership with environmental control of the "heat sink" requirement. Projects include Navy Blue, Atlas, Titan, Freighter, and the Century Series fighters. As well as year Defense Products Division, American Air Filter Co., Inc., 319 First St., Rock Island, Ill., Phone 389-8821.



## Microwaves Offer Radiation Protection

By George Alexander

Atlanta, Ga. — N. T-Space pilots may be exposed to controlled amounts of microwave energy during earth-based training to increase their resistance to solar radiation effects and may use medications and pharmaceuticals to assist certain physiological functions in a strong environment, the recent meeting of the Aerospace Medical Assn. was told here.

During experiments performed on dogs by the University of Rochester's (N.Y.) School of Medicine and Dentistry for USAF, Dr. Sol M. Moshinson said that preliminary results showed some relationship between microwave exposure and protection to intensity of a body from ionizing radiation.

Of 34 dogs exposed only to 360 millijoules of X-ray radiation, 21—or about 61 percent—wore an average of 15 days. Before being subjected to the X-ray power, six different dogs were exposed to 1,500 mej pulsed microwave

radiation at a level of 180 millijoules per 45 cm. Average times for the microwave treatment ranged from 3.5 minutes to 10 minutes and the time between microwave and X-ray exposure ran from 5-32 minutes.

When exposed to 140 millijoules of X-ray, only one of three untrained dogs died before the specified 18-day survival period. Four other dogs received the same microwave radiation for shorter times of 30-90 min. and with shorter delayed periods of 1-15 months between exposure to the two different types of radiation. This latter group experienced a mortality rate of 70%, representing a mix of naturally-treated animals, and the result of microwave treatment.

■ **Length of exposure is at least equal in importance to power level.**

■ **Time lag between microwave treatment and X-ray exposure has a significant effect in an organism's capacity to withstand the latter type of radiation, but more research is needed to determine optimum time.**

Experiments were varied. Microwaves and X-rays were directed against mouse areas on a whole-body basis, whereas control both radiations rely on their lower bodies or heads. Control dogs, for purposes of comparison, received only X-rays on their whole bodies, lower quarters and heads. Microwaves levels also varied, with some dogs receiving 100 millijoules/cm<sup>2</sup>, some receiving 165 millijoules/cm<sup>2</sup> and some receiving both levels simultaneously. Length of exposure also varied and some dogs received microwave after they had been exposed to X-rays. Others were treated to microwaves and X-rays at the same time.

More than 100 treatment more than four hours after X-ray exposure did not seem to prevent or lessen injury to the animal, but in all other instances where the dogs received microwaves before or concurrently with X-rays, death appeared to be less damage.

### Several Possibilities

Microwave use is common in cooking as well as in the pharmaceutical and suggested several possibilities, all of which would require further research, he explained.

■ **Increased metabolism** by microwaves of cell activity in bone marrow—an area very susceptible to damage by ionizing radiation.

■ **Lower body temperature**, apparently caused by adaptation of the organism to continued microwave exposure. During exposure, animal body temperatures drop, but continued application of microwave energy was observed to result in a creation temperature drop of 1 or 2° in the dogs.

■ **Altered metabolic response** of an organism caused by microwave which perhaps then inhibits further electron emission and block formation of free radicals by passing substances.

USAF Capt. Bruce E. Grawford, Aerospace Mktg. Laboratory, Wright-Patterson AFB, Ohio, said the testing had the objective of research and development in a number of areas using microwaves, including growth in the human body, blood cooling and a lowering of venous pressure. While this would not be overly unusual during flight as space Dr. Grawford said, it could lessen the respiratory system's adaptability to short new situations—such as sudden turns from strong orbital flight to the rapidly-decelerating and high positive g-force of reentry.

The effect of reentry on a pilot whose circulatory system had expe-

rienced a decline in adaptability while under prolonged stress could be comparable to a man trying to use and perform strenuous exercises after several weeks confinement to bed. Floating is not suitable in either situation, Dr. Grawford said, and should it occur during the events of a spacecraft, it could have fatal consequences.

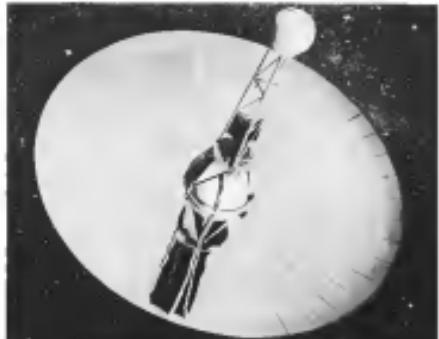
The USAF medical offices described some recent experiments conducted in a weightless Wright-Patterson aircraft on technique that had been developed to optimize the human's natural adaptation to space prior to leaving the tank after long periods of non-movement.

The technique involved a series of transients, whipping around the subject's thighs and upper arm. At first, the transients were rhythmically phased every other minute to a pace of 60 sec. of inactivity to shorten the venous blood flow and cause a pressure rise. Subsequent systole-diastole pressure wave maintained. In subjects equipped with the transients, while unopposed rats in the tanks tended to become inactivity and then 24 hr. of inactivity. Dr. Grawford said that the use of Dr. Grawford should be investigated to find one that would have the same result as the transients with or without a long non-systole-diastole effect.

Lt. Col. Norm E. Gonda, Naval Air Station at Norfolk, Va., presented a report on the possible interference caused by package aero on space activities. The Navy commander said that load of the regular solid rocket, as well as the probe acquired from tubes by Lt. Col. John Glenn and Major George Titus—moves from the upper half of the munition to the lower half under the force of gravity. It is possible, he said, that at that position, on reentry, the rotation of the system, begins at about middistance and forces load to maneuver transverse down to the probe, or opening from the mouth into the large intestine.

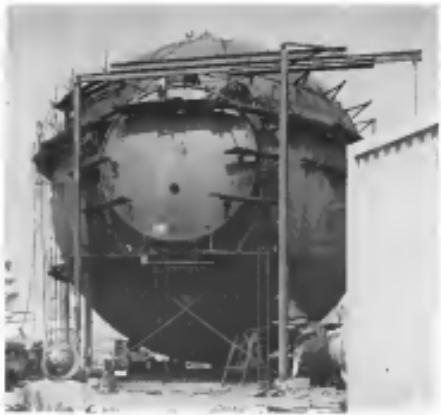
In the absence of positive gravity, Col. Gonda said, it is possible that load might be in the upper stratosphere above the reach of possible sensors and therefore cause some indiguration and errors as well as preventing the space pilot from deriving any benefit from the stabilized load. Col. Gonda suggested that it might be necessary to provide passive orientation in space for long periods with a drug that would stanch any peristalsis.

A USAF School of Aviation Medicine report on the combined status of glaucoma and radiation was presented by the institution's Dr. Max Robert W. Zellner. Dr. Zellner and his group had set out to determine if high glaucoma would lessen an organism's resistance to harmful radiation, thus doing instead that resistance was increased.



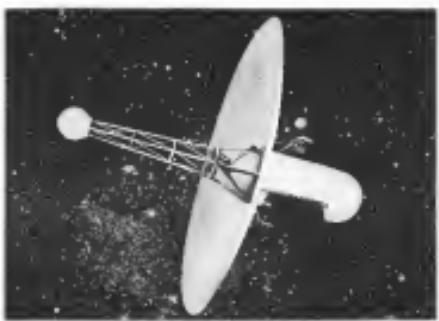
French Developing Phoeton Satellite

France's RTRP (Societe d'Etudes de la Propulsion par Reaction), owned by French aero and chemical companies, is developing the Phoeton satellite, designed to be launched into a low orbit and then progressively move under its own power, into a 24hr. orbit, performing scientific experiments on the way. The 600 lb. satellite will be equipped with a probe-like sensor which will allow the sun's rays on a memory board under Cylone shown in photo of the model, used to generate electricity utilized to operate instrumentation.



Hypersonic Wind Tunnel Near Completion

Vacuum system, with 100,000 cu. ft. capacity, will provide wind for hypersonic tests designed to test vehicles from 1.5 to 14 times that of sound. Tunnel, long built by Northrop's NACA Division, will simulate altitudes to 210,000 ft., temperatures to 3,000°



The USAF group and two groups of rats, one a control group for which the lethal dosage of cobalt-60 was established and the second as the exposed control. The experimental rats were mounted in a small special load carriage and accelerated up to 11g G-forces were positive, negative and transverse and doses of the cobalt-60 were graded, with exposure in the abdomen occurring before, during and

after rats in the load carriage.

Dr. Zellner said that the USAF group found that 5 g forces increased, as did the radiation level required for lethality. The USAF physician said there was indication that glaucoma may protect organisms in some as yet undetermined way against radiation effects. Radiation—particularly of the eye—can cause a temporary much after action in the broader sense. USAF Maj.



## Automatic temperature control GSE for Titan II missile propellant

This new environment control package was designed and produced by Hamilton Standard for the Martin Marietta Corporation's Titan II missile. It automatically stabilizes propellant temperature at  $60 \pm 5^\circ\text{F}$  within a 10,000-gallon storage vessel. The unit electrically heats or mechanically cools a glycol and water heat transfer liquid, and then circulates it to the storage vessel heat exchanger. It is built to perform reliably in ambient air from  $-35^\circ\text{F}$  to  $+115^\circ\text{F}$ , and from sea level to 6,000 feet.

The Titan II Propellant Temperature Controller is evidence of Hamilton Standard's ability to meet

environment control GSE requirements. It typifies the results attainable when engineering capabilities in pneumatics, hydraulics, electronics, and packaging, are combined with specialized manufacturing skills.

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Colonel F. Corkill, Armed Forces Field Laboratory, described a vibration testing system being developed for Air Force by White Corp.'s Western Electronics Laboratory, which will determine the vibration characteristics of explosive particles in space, their relative motions, the dose rate of each band and the overall dose rate of all bands and particles. Weighing a total of 62 lb., the system is scheduled to be balloon tested this summer and placed in a 600 cu. ft. high altitude test van by a Blue Streak launch vehicle or in a pogo launch vehicle should some other launcher.

Capt. F. W. Chisholm, Jr., U.S. Naval Medical Research Institute, discussed the use of ionizing chambers and ionization-chamber gains to measure ionizing radiation. Dr. Michael A. Sauer, University of Rochester, with USAF Maj. Lawrence T. O'Farrell presented a report on the prediction of human response to ionizing radiation by measurement of the metabolic rate as indicated by temperature drops or rise—so that space flights could be recalled when dosage levels begin to approach the danger point.

Robert J. Henrich and Robert W. Coste, Battelle Research Laboratories, told the session that their studies of vibration effects on human performance had essentially confirmed the earlier findings of H. E. von Giebel that the frequency range of 15 to 25 cps was particularly critical for human performance.

The two scientists noted that low frequency vibration induced in human subjects longer reaction times in the making of decisions, decreased tracking

ability (in the analog of data, digits and symbols), loss of visual acuity, reduced speech intelligibility and decreased respiratory rate and increased oxygen consumption. They said that with the development of human vibration tolerance, which "are more likely to be excited at lower frequencies," spectrum would have to be designed so that dose rate levels will fall below critical levels and that certain frequencies would be attenuated. Design of a spaceflight platform and equipment also would have to take allowances for the stresses induced as a result of vibration.

Concurrently with work on vibration in the 0.27 cps range in the Battelle Co. was reported by F. W. Sander of the government's Wright-Patterson Air Force Base, Dayton, Ohio, that the "Test on vibration, using a single, two, an octopus, single and a center column, three-axis pendulums and a platform all mounted on a vibration table. Amplitude of 20 in. peak to trough, and an elevation of 10° to 15° could be achieved as the maximum."

Sander said that it was found that test subjects would accept higher frequencies at higher g forces, even reported 15 cps as "slamming" (the highest level of vibration at slightly less than 1 g), as they called. It can be about 7.5 g. Sander said that vibration degraded some performance tasks but not others—such as high acuity tasks—and that it was not dependent on frequency or amplitude.

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There appeared to be no agreement during the session on the exact frequency difference between EBD, EBO and EBD<sub>2</sub> vibrations, but it was stated that the platform to track declared rapidly above 0.75 g/sec. The three Army agencies pointed out that for a spacecraft with a liftoff rate of 0.5, the maximum acceleration onset rate of a 10g accele-

ration would be about 0.5 g/sec—within the trained pilot's ability to perform safely.

## Soft X-Ray Probe Tests Planned

Four rocket probe studies of soft X-ray emission from sources in deep space will be conducted this summer by National Aeronautics and Space Administration at Wallops Island, Va.

The experiments, planned by Lockheed Missiles and Space Co. plasma, will use new types of plasma controllers being refined in prototype form. They will be launched by Space Gemini Attitude rockets from existing pads at the NASA launch facility. Soft X-rays have energy levels between 100 and 10,000 softs and have the penetrating power of hard X-rays. They are not yet strong enough in earth's atmosphere and are to be measured in space by instruments aboard rocket vehicles. Soft X-rays are electromagnetic radiation with a wavelength slightly shorter than ultraviolet and they produce similar effects.

Radar and satellite observations have shown that soft X-rays are emitted by the corona of the sun when temperatures are about 1 million degrees Fahrenheit. Scientists assume that other stars have coronas which should produce soft X-rays that would be detectable outside the earth's atmosphere. The first probe will have a 10,000 softs soft X-ray and ultraviolet to measure plasma electrons against to earth's atmosphere. Lockheed physicians say that experiments should be named "solar softies" to enhance the designation of soft X-ray studies in space.



### Photo-multiplier Tube

Photo-multiplier tube, which requires a glass envelope to reduce air noise and interference that can interfere with the tube's operation. Tube, developed by ITT Industrial Laboratories, Inc., Wayne, Ind., has electron multiplier gas of 200,000 at operating voltage of 2,000 v, ITT says.

Test also indicated that for the same g force, a pilot can perform the same



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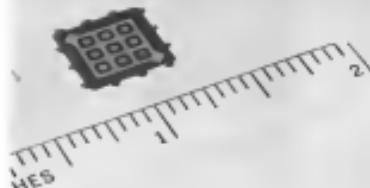
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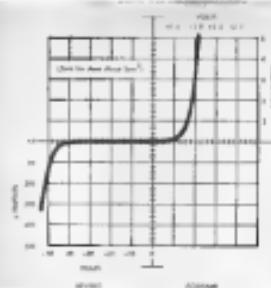
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**SILICON P-N JUNCTION DIODES**, produced by thin-film deposition on a ceramic substrate without use of seed crystal by Sylvania (left), open the way to producing complete integrated micro-circuits with active elements in a single manufacturing operation. New thin-film diodes exhibit square-law characteristics (right) of diodes made by conventional processes for general-purpose use.



## Thin Film Diodes Achieved on Ceramic

By Philip J. Klein

Waltham, Mass.—Single-layer P-N silicon diodes have been successfully fabricated by vapor deposition on a ceramic substrate using a new technique developed here by the Microelectronics Laboratory at Sylvania's Electronics Systems Division.

The subsidiary of General Telephone & Electronics Corp. now is applying the new technique to the problem of producing thin-film transistors on ceramic substrates. If successful, it would be a major breakthrough in the field of microelectronics.

Sylvania has deposited up to nine single-crystal silicon diodes with diameters up to 0.1 in. on ceramic wafers measuring 3 in. square. Its low-silicon diodes are 100%—near-god diodes not of mere deposited.

Like other companies working to develop techniques for depositing active semiconductor devices on a foreign substrate (non-conductor, non-single-crystal), Sylvania has been obtaining verification action from the few firms that have nearly a year. But it is only within the last several weeks that the company is able to produce diodes with the characteristics "guaranteed" performance of diodes made by conventional techniques, according to Gerald J. Schon, manager of the Microelectronics Laboratory.

The diodes which Sylvania is producing by the new process have performance comparable to modern pacard

general-purpose diodes produced. With additional work, the company hopes to produce devices with improved characteristics.

Sylvania is understandably secretive about the new process. It will only say that the process involves an "epitaxial technique on a ceramic substrate with special surface treatment but with no single crystal used on the base."

### Other Advances

The company-funded micro-circuits program, which has been under way for about three years (AVW May 9, 1964, p. 107), has now included other significant advances in this thin-film technology. These are based on use of a 20,000-volt electron beam, rather than lasers, focused to a spot size of 0.06 in. in diameter, equivalent to a power density of 14 million watts per square inch. This is adequate to vaporize high-temperature materials and refractory materials. Vaporization takes place at a vacuum of around  $10^{-4}$  mm. Hg.

Sylvania is continuing its research in basic thin-film technology, but has just opened up a new pilot production environment facility here at Waltham. At one technique each the required time is 10 minutes. They will be able to produce the pilot products in one week. Most of the more advanced techniques developed before have been scheduled for potential introduction in the pilot production facility during the next 18 months.

One example is a newly devised tech-

nique for coating the surface of ceramic wafers with an extremely thin layer of high-temperature glass, which is less than one-half mil (0.0005 in.) thick. This provides a substrate for deposition of thin-film components which can have the strength, best resistance and thermal conductivity of ceramic with the extremely smooth surface characteristics of glass.

Such glass-coated substrates can operate at temperatures up to 1600°C. Samples have been heated to 1300°C, then quickly plunged into -30°C liquid nitrogen without breakage, warping or separation of glass from ceramic substrate.

The glass surface permits fabrication of conductors and insulators with narrow widths that is possible on uncoated ceramic, increasing the amount of circuitry which can be produced on a single wafer. The new glass-surface process is expected to go into use in the pilot production facility this fall.

Sylvania currently is using ceramic wafers which measure 5  $\times$  5  $\times$  0.01 in., but is working on 1 in.  $\times$  1 in.  $\times$  1 in. as well to add to provide greater flexibility.

### Higher Resistivities

Initially, the pilot production facility will use materials for resistivities of thin-film resistors, which has a resistivity of about 100 to 500 ohms per square.

Later this year, the company expects to introduce modified carbon deposited



**NEW SYLVANIA PILOT PRODUCTION FACILITY** initially will use conventional techniques to produce deposited passive circuitry with ceramic micro-devices and insulation. New, more advanced techniques developed in the laboratory will be introduced this year. Vacuum chamber is new facility is controlled from console (2). Micro-circuity (3) is deposited on ceramic wafer (1) which is encapsulated. (1) Introductory batch (3) with antireflection coating (not visible) before group of wafers whose electrodes receive holes (4) before bonds are added to the bond (5).

resistor having a resistivity up to 5,000 ohms per square, with a corresponding reduction in gain required for resistors on the substrate as insulator in maximum resistance obtainable. By using such techniques with the carbon, it is possible to control the resistivity, coefficient and resistivity of deposited carbon resistors.

In the laboratory, Sylvania is able to produce deposited audience resistors to tolerances of 2% through use of resistors, but currently is achieving 10% tolerance in its first pilot production line output. With additional experience, the company expects to achieve 10% figure, perhaps down to 5%. Sylvania is convinced that 2% tolerance can be achieved in the pilot production facility when deposited carbon is refined.

In the long range of advancing Justice techniques at the cost of thin-film capacitors and for increased memory values, General Telephone & Electronics Research Laboratories in Brooklyn, N.Y., are investigating human resistance, which has a dielectric constant that is more than 10 times that of maximum dielectric, while which appears adaptable to the dielectric being superimposed present used for insulation of other circuit elements.

For insulation, Sylvania has recently ignited and developed a brand of carbon materials which permit it to obtain a vertical and horizontal and other transverse properties that are comparable with carbon used for other thin film components with which the conductors are in contact. The present test includes capacitors, aluminum, beryllium copper, gold and bismuth.

In the laboratory, Sylvania has been able to fabricate deposited conductors with line widths as small as two mils (0.0005 in.) and hopes to achieve these same standards in its pilot production line by the fall.

To reduce line widths, Sylvania is changing the process used to manufacture deposited resistors. Instead of using carbon, which usually results in under-cutting, which broadens the resistors, carbon is switching over to building up the resistors as by electroplating processes.

### Packaging Method

The first source ceramic wafers to be used in initial pilot production have been small tiles protruding along each of the four sides. Gold-plated tiles are deposited on a array of these tiles in the epitaxial squares to provide for electrical connections.

Once the circuit has been fabricated, it is first coated with a flexible silicone to provide a cushion around the circuit. This is encapsulated in an epoxy resin in a rectangular form factor.

Current laboratory work with silicon dioxide suggests that it may be more expensive for the initial circuit protection function prior to epoxy encapsulation.

To reduce the weight and encapsulated circuit into a module, Sylvania has used small rectangular interconnection boards, resembling computer pig boards except that they have are rectangular instead of circular. The interconnection boards between diodes are screened and fixed on the surface of each board. The interconnection boards are then placed



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For information, contact J. W. Waite, Dept. 14-A, P. O. Box 358, Sunnyvale, California.

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## FILTER CENTER [REVERSE]

► **New Name** for Electronics-Special Air Force-Lorraine, formerly identified only by number, has been officially given new popular name. This is likely the following:

■ 0242. Guideline (Air Weapons Control System).

■ 0352. Meteor (Weather Observing & Forecasting System).

■ 0742. Headwind (Headquarters USAF Command & Control System).

■ 4842. Sparrow (Air Force Communication System). The Lorraine for likely was known as Arrow.

**Electrochemical Fuel Cell Program** — Planned—Army Signal Corps has issued requests for proposals for research program aimed at development of a fuel cell which can store hydrogen and/or oxygen to generate electricity.

► **Martin Developing Laser Radar**—A 15 lb portable laser radar for battlefield use, to measure range of targets such as tanks and artillery, is being developed by Martin Company's Orlando Division. Components are the laser radar could be ready for mass production within a year.

► **Brionics Conduct Micro-Miniature Iodine-Brilouin among ingenuity**—Infrared technology innovations are being planned to carry small brilouin to enable them to send video signals which are not so easily compromised with the naked eye. At least a dozen pairs of apertur glasses are in evidence at the annual Institute of Radio Engineers convention in New York. One engineer sitting in the front row, less than 20 ft from the screen, was seen using his apertur glasses, giving some indication of the use of the slide material.

► **Navy Plans Acoustic Maintenance Study**—Naval Training Center, Port Washington, N.Y., is in the early stages of capable of conducting research program to evaluate various troubleshooting techniques for electronic equipment. Program will include recommending training equipment to extract as much as possible to the most effective troubleshooting techniques. Other upcoming research and development programs include:

■ Optimal modulator with high information rate capability, suitable for use both with coherent and quasi-coherent light source and capable of transmitting at least 25% of the light emitted by the source. Acoustical Systems Division, Wright-Patterson AFB, Ohio.

■ Digital computer techniques capable of calculating the dynamic response

characteristics of a jet engine and its control system. Acoustical Systems Division, Wright-Patterson AFB, Ohio.

■ Two silicon integrated circuits, one capable of performing digital logic and the other designed for continuous-wave linear amplification, to be housed on a single silicon chip being developed that this present division, Army Signal Support Agency, Fort Monmouth, N.J.

► **Japanese Research Bibliography Available**—First Bibliography of Japanese research in science and technology compiled by Commerce Department's Office of Technical Services, is now available. Entitled "Japanese Science and Technology," \$8.00 can be obtained for 10 cents from OTS, Consumer Dept., Washington 25-1312.

► **New Navy Use For Tacon-Tacon** weapons sets in Navy fighters will be modified to enable use aircraft to determine its distance from another, for aerial rendezvous, in addition to conventional role of determining aircraft bearing and distance from ship-based or ground-based Tacon station. Modification will which will give Navy Tacon into the added capability will be provided by General Dynamics/Electrospace under a \$2.1 million contract. Principal element in the modification is a completely transponderized omnidirectional which will be substituted for the present transponder tube unit.

► **USSR Reopen Gravity Wave Studies**—Soviet interest in the study of gravitational waves is evidenced by some article which evaluates the energy generation of gravitational waves in the propagation of light in vacuum and wave with or without field. The Soviet article says that calculations based on tensor analysis indicates that for intermediate fields, the ratio between the squared gravitational and light amplitudes is  $10^{-14}$ . If the light wave base in a constant field is 10 mm, The article says that the general relativity theory which provides the possibility of transforming gravitational waves into light waves, but this process is rather difficult. The article by M. Ye. Gor'kov, appeared in "Experiments in Theoretical Physics," Vol. 41, 1967, p. 113-114.

► **Boeing Antipot To Fly Japanese Helicopter**—Edgar P. Boen, division of Boeing will use a 20 ft long PB-20 helicopter (PB-201) to Nihon Aerospace Manufacturing Co. Ltd., Tokyo, for use in company's YS-11 twin-turboprop 52-passenger helicopter. The PB-20 is expected to weigh less than 55 lb.



**BEECHCRAFT MODEL 90 QUEEN AIR** aircraft are shown in assembly line along with earlier Model 65 version. Production of eight Model 65 per month is scheduled for late this year. Current backlog for the new Queen Air version according to Beech, exceeds \$5.5 million. First in long-haul was shipped to Beechcraft GmbH, German Bosch distributor in Hamburg.

## Queen Air Power, Performance Increased

By David H. Hoffman

Teterboro, N. J.—Beechcraft Model 65 Queen Air—essentially a Model 65 with more powerful engines and a swept-in-cowl engine intake—provides increased performance and cuts climbing speed while retaining all the responsiveness of the Model 65.

For example, single engine rate of climb at maximum continuous power of the two-engine Model 65 increases to 1500 fpm. The comparable figure for the Model 60 is 750 fpm, or greater by about 50%. At takeoff power, single engine climb rates for the Model 65 and Model 80 are 245 and 335 fpm, respectively.

### Cruising Speed

Somewhat less impressive is the Model 65's higher climbing speed, which, at maximum gross weight, is about 12 hr. and 30 min. faster than that of the Model 65.

During a 1 hr. and 30 min. flight with Marvin Snell, manager of Queen Air sales for Beechcraft, this Aviation Week pilot found that the Model 65 excels in climb and cruise speed.

The rugged twin possesses all the qualities noted by Aviation Week in its original evaluation of the Model 65 (AW Oct. 26, 1959, p. 144). And, for its 3,000 lb. weight, it also appears easy to maneuver from a potentially disastrous situation.

### Stall Experiment

At 2,500 ft., for example, we applied 65% power and let the engine run a sharp 15 deg. hook and pull its nose up sharply to induce stall. At speed, following all speeds, reached 85 mph when the tail warning horn sounded. The tail still flew at about 70, marked by a dead load, in which the aircraft tried to roll itself out of the turn.

As we started a recovery, Snell lagged the bows of the control stick all the way back, and the Beech began a rhythmic buffet. Holding the stick full back, he made several turns to prove that the Model 65's ailerons return their effectiveness deep into the stall region.

Rate of climb indicator was signaling a 700 fpm descent when Snell discontinued back pressure on the stick.

The Model 65 promptly flew itself out of the stall without further encouragement.

Base price of the Model 65 is \$136,000. Moving up the scale, the Gran Canaria version, at about \$140,000, is the next new aircraft designed primarily for executive flying. It is a two-power version between the Model 60 and the Queen Air, that accommodation has 1400 ft. with light, nonstop flight aircraft such as the Jet Commander, the SAAC 25 and the Piaggio P.108.

### Competitive Assortment

On the low side, the Model 60 will be pitted against Avco Commander's Model 608F, which has a base selling price of about \$138,000. Conversely, the Model 60 is competitive with Beechcraft's own Super 33, at about \$112,000, and with the Model 65 at \$136,000.

Because of this intra-corporate competition to sell three aircraft models, general managers of the firm, as is considered probable that Beech will retire the Model 65 from its product line as the two less distinct forms. This year, however, the company will continue to

make the Model 65 available on 120-day leases. The reason for doing so probably stems from a high price in comparison to the Model 60, and the fact that some may find the \$8,000 price differential between the Models 60 and 65 dubious.

According to Beech, part production schedules show that four will result as the rollout of eight Model 65s per month. As of last month, the total retail value of Model 65 orders exceeded \$5.5 million.

The aircraft flown by Aviation Week, N935Q, was equipped with \$29,750 worth of optional devices—a heavy load made flying in pleasant if one could have influenced the evaluation. The aircraft was very light, weighing not more than 1,000 lb. at the time of first takeoff, and therefore was unusually more responsive than a fully loaded Queen Air.

### Reeey Cabin

Entering the aircraft, we noticed first the spaciousness of the Model 65 cabin, with 57 in. of head room, and the presence of a lavatory. Neither feature represents a change, but both set the aircraft off from its stable predecessor that can remain airborne as long as the Model 60.

Along each side of the Queen Air's cabin are three large windows. In a right turn, the pilot in the left seat has excellent aft visibility. Smaller windows on a stepped cabin would leave less to the side on a right turn.

On the left, because of the regular cabin equipment, a pilot should not leave the application of full rudder power, but we noted no lag between rudder movement and engine response during our brief roll down Teterboro's north runway. Nose wheel steering, controlled by foot pedal pressure, could be fragrant at 90-60 hr. when the rudder becomes effective. Steering is not a hydraulically assisted system on the Queen Air, and we found that even the heavy-handed pilot need not waste about cross-feeding the rudder's movement while walking.

During Army Instrument Landing System approaches at MacArthur Field, Long Island, we judged the aircraft extremely stable. It seemed to want to swing any turn over from the glide path or localizer and could be flown almost hands off down to minimums. If a little power is retained during round out, it can be used to swing a decent landing from a high flap. The Queen Air tends to settle gradually in the landing configuration as thrusts are returned to the six thrust position.

At 3,000 ft., we looked at the right engine and the Queen Air moved gently into it. Opposite radio height, the nose back to its original heading, and we began rolling in turn to get back-



**MANUAL MASTICURE CONTROL** lever has precise cruise adjustment as on right side of Model 65 cockpit with fuel flow meter, vertical speed indicator at left. Radar is RCA AVQ-15, optional to \$31,400 installed.



**LYCRA 1956-1960 340-ATA engine develops 180 hp at sea-level. Stroke has been increased 0.5 in. over 340-A engine on Model 65, increasing weight about 60 lb. per engine.**



**SWIFT F14**, which provides Model 133 Queen Air with its distinctive look, also gives greater range and longer range to provide effective control with main powerplant.



# When every ounce counts

Atmos has a new Model 405 servoset which weighs only 5 ounces. It is currently specified on many military programs where reliability, size, and weight are prime considerations.

The first stage of these miniature valves weighs the metals exclusive *Jet-Pipe* principle used in all Atmos valves. That allows it to receive and pass on particles as large as 150 microns without malfunctioning.

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**University of California, Los Angeles** 1968-69 For study of wave dispersion properties at high temperature produced by steady waves. 800-1000° for study of wave dispersion properties.

**University of Delaware, Newark, Del.** 800-1000° For study of heat transfer of high temperature plasmas and their applications to the plasma measurements.

**Long Island Geological Association, Inc.** 1968-69 For study of wave dispersion properties of natural vibrations.

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## NEW AEROSPACE PRODUCTS

### Synchro Test Device

**Synchro Test Set Model MST-255A** is designed to measure many synchro characteristics outlined in Department of Defense Specification MIL-S-21706A. The device has switch-selective open, low and short-circuiting jacks to test electrical synchro, electrical servo, mechanical and null null null.

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**Theta Instrument Corp., 130 Victor St., Saddle Brook, N. J.**

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Manufacturers says the instrument can be operated at high speed to unspecified precision and is adaptable to all shaft and housing configurations. It can save 5 to 37.5 deg in angular error over 15 sec. at 360° maximum, 180 deg range, positioning at 1 deg/second with a detent mechanism and at other angles with a continuous, fine angle device, and has a repeatability of 6 sec. of 10 minutes.

**Theta Instrument Corp., 520 Victor St., Saddle Brook, N. J.**

### Fluid Ratio Control

**Model 2707** is designed to eliminate fuel-economy ratio shifts in reciprocating engines, regardless of engine orientation or drops in fuel pressure. Unit also can be used to divide one fluid into two equal or unequal quantities. Operation is virtually free of friction due to lack of dynamic seals, the entire fixture sits, and vibration and assault entries are maintained by balancing moving elements on variable rate.

**Principles, Inc., 11071 Rivers Rd., Santa Fe Springs, Calif.**

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101-1001-102

## WHO'S WHERE

(Continued from page 25)

## Changes

Walker Dell, senior research manager, Prost & Walker Aircraft Division of United Aircraft Corp., and C. E. Hulberg, B. master manager, with others at the Convair/Cessna Advanced Nuclear Engineering Laboratory (CANCEL), Middletown, Conn.

Edgar R. Bowles, master chief engineer, Grumman, formerly Convair Corp. D. R. Clegg, also from the Convair/CANCEL manager, Convair/CANCEL Research Laboratory, Frisco, Tex.

Donald C. Goss, formerly with Santa Monica, has announced the following appointment: Robert J. Coopers, director of performance evaluation and products, A. J. Goss, director, director of corporate planning and research.

**John J. Murphy**, former Air Force representative for the Military Electronics Division of Motorola, Inc., with offices in Washington D.C.

A. E. Finsell, director of advance designs, Vision Division, Northrop Corp., Van Nuys, Calif., and Theodore W. Kaeser, chief of technical staff, Pennsylvania Research.

J. M. Cummings, general manager of space engines, Rocketdyne, a division of North American Aviation Inc., Canoga Park, Calif. Also J. E. Knoll, assistant general manager and acting manager of space engine manufacturing, and S. J. Donohue, chief engineer. J. E. Thompson succeeds Mr. Knoll as director of engineering, aerospace division. Rocketdyne and W. E. Fox succeeds Mr. Thompson as director of facilities. R. E. Mess, proposed, is promoted to Rocketdyne, a permanent responsible his special technical assignments.

Alexander Sulin, director of long range planning, General Precision, Inc., Tarrytown, N.Y.

© Wesley Marshall, director of general planning, Curtis-Wright Corp., Wood-Ridge, N. J.; Curtis-Wright's Curtis Division, Caldwell, N. J.; his associates, Donald B. Woolf in management planning, and Jack H. Bierer, manufacturing

J. Walton Colvin, manager of plant and program, Council Dynamics/Electronics, San Diego, Calif.

John W. Senders has joined the Engineering Psychology group at Bolt, Beranek and Newman, Inc., Cambridge, Mass.

The Cawley Corp.'s Johnstone Manufacturing Division, Los Angeles, Calif., has announced the following senior engineering staff appointments: Dr. Edward W. Hartung, project engineer; Maurice E. Modest, project engineer; George S. Stroh, project engineer; Dr. Bimal Patel, senior engineering specialist of Aerodynamics; John Weller, project manager for a new environmental control system being developed; Dr. Paul Bonsu, research specialist.

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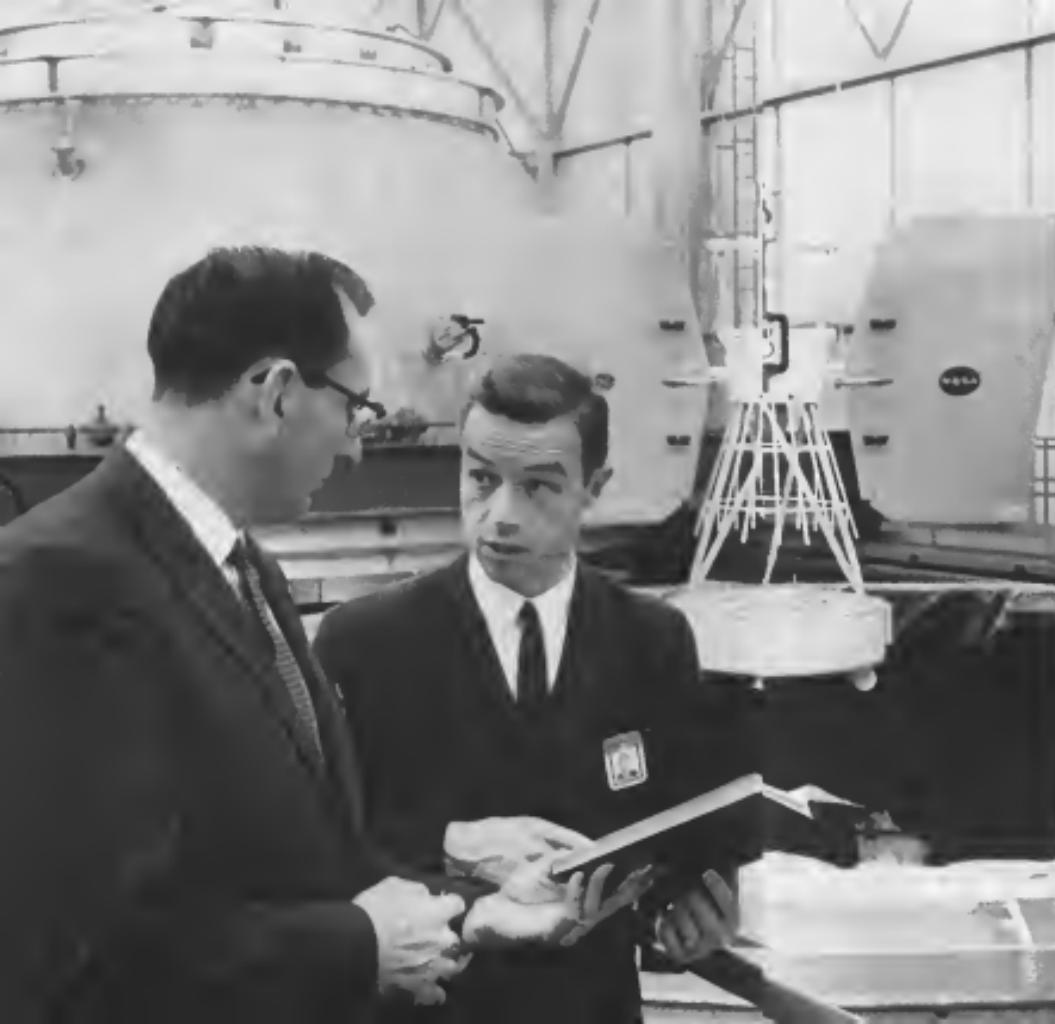
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## PROBLEMATICAL RECREATIONS 116



A drawer contains an odd number of pairs brown socks and an even number of pairs black socks. What is the least number of brown and black socks such that the probability of drawing two brown socks is 1/6 when two socks are chosen at random from the complete collection?

—Continued

Soon our Data Systems Division for several causes in digital computer and display systems. We're looking for engineers with new views on the subject. Look up Mr. Harry Lurie if you qualify. Anyone is eligible for a free copy of our third collection of puzzles from this series, *Problematrical Recreations*. A card to the series Mr. Lurie will bring the booklet to your door.

ANSWER TO LAST WEEK'S PUZZLE: 588 miles.  
 $(337 + 567 = 167 + 637 = 837)$

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## Space Oscar

Mr. Frank, in the *Space Monitor* (March 20), from the *Journal of Commerce*, quotes the successful flight, but he, however, has a case to sue if any of the suppliers whose products subsequently caused the difficulties of the mission. I am speaking of America (I am only now their public relations counsel) as a company who supplied the small head of the oxygen tank and the valves. Please accept my thanks for the excellent coverage that so many photographs. For a commercial site of equipment not produced to a Mil Spec, to have to be fixed is a poor tribute to the designer and manufacturers.

Alan C. Cottrell,  
Cottrell Corporation,  
North Hollywood, Calif.

## A Patent Case

The issue of ownership of patents on inventions developed according to work on government contracts has come up in recent years and discussions throughout the country—but not political and editorial angles as well as among technical personnel.

There appear to be two highly vocal and apparently opposed viewpoints on the matter. The fact is that the government may provide some funds, but put the invention and development development to more political and government people a clear basis for full ownership of patent rights by the government as standard existing thus programs thus financed. On the other hand, the contractors and their attorney's have emphasized the fact that the power facilities planning and decisions are provided to the contractor as follows in a proportion of the funds and, therefore, the government does not legally deserve any share of the profits of the patent rights, and the new share of the profits of the invention and the contractor would therefore be more equitable. In Department of Defense contracts, the sharing is presently provided by extending rights to the agency and the situation of the patent holder retaining the patent itself in the contractor.

This makes it possible for the contractor to develop and profit from my commercial advantages while the patent may provide what at the same time permitting the government to use it.

It appears to me that the two viewpoints do not fit in all their details better than the full profit from past rights should go to those who provide the source and not to you for the development of an invention that is a public service.

In all the various details which it goes to, the maintenance of the individual job with others from whom the invention has been developed is greatest. Only consider me to me, I consider that no one has ever been produced merely by the spending of money. I am sure that no one that an invention has ever been produced merely by management teams, resource facilities or management alone. Although these ingredients are durable, and position

of its readers on the issues raised in the manufacturer's original submission. Address to the Editor, Aviation Week & Space Technology, 1250 Avenue of the Americas, New York, N. Y. 10020. Try to have letter published with name to give a greater identification. We will not print anonymous letters, but names of writers will be withheld at request.

It is often times essential to understand that an employee is incapable of practicing any art. Only by the study of each and every field of knowledge can a new idea come. In addition to methods of organization, another ingredient is necessary to produce novel new when reading or patents—the third ingredient being the intelligence inherent within human, hard work or sometimes plus plus intelligence, of course.

In many companies this contribution is by the individual himself or anyone it is rendered by providing a chart or the extra profit resulting from his invention. It should very much however, that the sharing of the profit is not present in all cases. All or none of the expense in government contracts are required to agree that employees are entitled to some form of the rights to ideas and inventions which are created will be turned over to the contractor so that they can be used. They are then compensated to transfer these ideas to the government. When the government owns the patent under the individual contract, the inventors can receive a direct return, even when the rights have been transferred.

A return to the inventor is only possible when the company issues the patent and therefore, able to turn over a share of identifiable increased profit.

The present Department of Defense will not provide any suitable compensation or the individual inventors for the work of the contractor involved. On the other hand, the patent of NASA and FAA, calling for ownership of patent by the government prevents a company from properly compensating individuals for their often considerable time and effort in the development of a new invention.

This patent policy should properly recognize that these are those contributions to the development of new ideas. There are in order of importance three sources and bodies of the inventors, you and me, the government, and, of course, the government policy, there is little consideration for the inventor himself.

I suggest that the government company management and engineering or organization should do well to understand these points and the financial needs to obtain the development of new ideas to re-establish the importance of basic. A good patent policy would provide adequate incentive to inventors to use their imagination and intelligence in the development of all invents, even whether they work there or not, and to be rewarded for their efforts and not only in the field of basic research, but also in the field of application to people, the men who produce. The idea, and at the same time would protect the government's investment of money. It should easily be possible to

turn these objectives of protected patent as a protection against patent hold-ups.

• Ownership of the patent by the contractor, provided the company had a patent rights adequately compensating the inventors.

• Royalty-free rights in the government when the government helped finance the development as part of a contract.

• Exclusive management rights to the contractor to make proper provision to share extra profit resulting from such commercial rights with the contractor.

Eric M. Jackson  
President  
Avantek Amersons, Inc.  
Cochranville, Md.

## Navy Surveillance

With the "Space Attorneys" paragraph of the "Navy Space" (Space Technology, October 1967) I am concerned that Navy policy in space includes that Navy Space Surveillance System is a part of Space Track, and that the Navy is assigned only one quota of orbital slots, namely, one, in the "Orbital Registration Machine."

Statements such as the aforementioned, although unintentionally as are, are not only disengaging to the general public, but also disengaging to those who are in in research, scientific detection and tracking in the Navy.

A more correct statement of fact concerning the United States Naval Space Surveillance System, as related to the NORAD Space Defense and Tracking System, is as follows from the speech of the Secretary of Defense, Robert S. McNamara, before the House Committee on Armed Services:

"Clearly related to the problems of defense against ICBM attack is the potential problem of defense against missile attack. The first task is to detect, track, and identify missiles in flight. We are doing this with NORAD Space Detection and Tracking System (SPADATS)."

This system consists of two major component parts under the control of NORAD. The Navy's Space Surveillance System (SPADS) operates a fleet of detection satellites in geosynchronous orbit. Each satellite has a receiver and computer center located at Dulles, Va. The second component of SPADATS is the Air Force Space Track System, from a series of radars located on the North American continent."

Although this statement about the Navy's role in the detection of missiles does not mention the Space Surveillance System, it does refer to the Navy's only satellite tracking program, the constellation or tracking. It is the U. S. Naval Space Surveillance System that is mostly referred to as the Navy's first major space system.

D. G. VANCE  
Captain, USN  
Commanding Officer  
U. S. Naval Space Surveillance System  
Dulles, Va.

## Information About Hose Made of Teflon From The People Who Invented It

No. 1 in a series

## SIGNIFICANCE OF COLOR

Resistoflex originated and in 1953 introduced hose assemblies made of Teflon\* via gas turbine applications. Since then millions of assemblies have gone into service in all areas of the aero-space industry, and an outstanding record for performance and reliability has been compiled.

You have undoubtedly observed hose tubing made of Teflon in many colors, with black being predominant. Black is the color of the hose developed and manufactured to this day by Resistoflex. In fact, Resistoflex and its licensees, here and abroad, manufacture black hose ONLY.

The black color is a result of a carbon block component being added to the Teflon extrusion compound by a process covered by Resistoflex Patent No. 3,752,637. The purpose of the carbon block is to act as a moderator for the large liquid entrainment-lubricant fraction of the Teflon resin mix. Its excellent absorption characteristics and the particles are uniformly dispersed throughout the mix. Despite the

numerous colors it has not yet made any difference.

most exacting controls, Teflon resin displays a wide range of lubricant retention capability. Hence, the carbon block particles, in their function as a moderating agent, serve as suppliers of additional lubricant or receivers of excess lubricant during the passage of the resin mix through the vital constraining throat of the tubing extrusion die. For this reason black tubing has consistently shown uniformity of structure.

Some have assumed carbon block was merely a color coding for identification. Some have even thought coloring was to hide defects. Some colorings used, because of their poor dispersal characteristics, have resulted in serious agglomeration problems and unreliable structure. Uncoated hose, while not aggravated by the improper use of pigment, continues to be plagued by structural defects resulting from the variation in resin lubricant absorption capability.

Therefore, Resistoflex will continue to manufacture black hose by the same methods that have been so well proven in field service.

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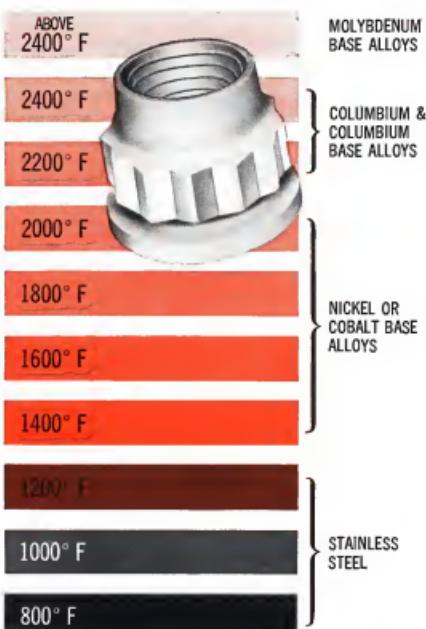
Recent ESNA engineering developments include:

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3. A nut for space vehicles which can endure short periods at up to 2700°F while maintaining locking torque resistant to high vibrational loads when returned to lower temperatures.

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ESNA may be able to suggest a standard production item to solve your high temperature application problem. If no ready-made answer exists, ESNA has the capability—and the interest—to work with you in the creation of a special solution. Call MURdock 6-6000, Ext. 201, for engineering assistance. For information about standard high temperature Elastic Stop nuts, write Dept. S74-425.

## HEAT COLORS AND APPROXIMATE MAXIMUM WORKING TEMPERATURES OF VARIOUS METALS



## Some practical ESNA solutions



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**LH3610**  
Special close-clearance nuts to develop tensile strength of 1800°F of same material at temperatures—300°F to 900°F when used on bolts of same material. AMS-6304 chrome moly vanadium steel, silver plated. Sizes 10-32 through 3/8"-24.



**LH4167**  
High performance nuts to develop full strength of 1800°F of same material at temperatures—300°F to 1400°F. Used for reduced times and loads up to 1800°F. Reine 41, silver plated. Sizes 10-32 through 3/8"-24.



**ZL4361**  
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**RG38-2644**  
Radial gang nut strip for flange assemblies, to develop full strength of bolts of 300 KSI or 300 stainless steel at 1200°F. Nut—AISI 347-FM, silver plated, size 5/16"-24. Channel—AISI 321 passivated.



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